MATHEMATICS-IX

Module - 3

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EUCLID'S GEOMETRY

1. **Postulate :-** The basic facts which are taken for granted, without proof and which are specific to geometry and called postulates.

2. **Axioms :-** The basic facts which are taken for granted, without proof and which are used throughout mathematics are called axioms.

3. **Theorem :-** The conclusions obtained through logical reasoning based on previously proved results and some axioms constitute a statement which is known as a theorem or a proposition.

4. **Point :-** A point is represented by a fine dot made by a sharp pencil on a sheet of paper.

5. **Plane :-** The surface of a smooth wall or the surface of a sheet of paper or the surface of a smooth black board are close examples of a plane.

6. **Line :-** If we fold a piece of paper, the crease in the paper represents a geometrical straight line. The edge of a ruler, the edge of the top of a table, the meeting place of two walls of a room are also examples of a geometrical straight line.

7. **Incidence Axioms :**

Axiom 1 :- A line contains infinitely many points.

Axiom 2 :- Through a given point, there was infinitely many lines.

Axiom 3 :- Given two points A and B, there is one and only one line that contains both the points.

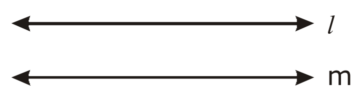
8. **Collinear Points :-** Three or more points are said to be collinear if there is a line which contains all of them.

9. **Concurrent Lines :-** Three or more lines are said to be concurrent if there is a point which lie on all of them.

10. Two distinct lines cannot have more than one point in common.

11. **Intersecting Lines :-** Two lines whose intersection is non-empty are said to be intersecting lines. The common point is called the 'point of intersection'.

12. **Parallel Lines :-** Two lines l and m in a plane are said to be parallel lines if $l \cap m = \phi$. If l and m are parallel lines in a plane, we write $l \parallel m$.



13. **Parallel Axiom :-** If l is a line and P is a point not on line l, there is one and only one line which passes through P and is parallel to l.

14. Two lines which are both parallel to the same line, are parallel to each other.

15. If l, m, n are lines in the same plane such that l intersects m and n || m, then l intersects n also.

16. If l and m are intersecting lines, $l \parallel p$ and $q \parallel m$, then p and q also intersect.

17. If lines AB, AC, AD and AE are parallel to a line l, then points A, B, C, D and E are collinear.

18. **Line Segement :-** Given two points A and B on a line l, the connected part (segment) of the line with end points at A and B, is called the line segment AB.

19. **Interior Point of a Line Segment :-** A point P is called an interior point of a line segment AB if P $\in$ AB but P is neither A nor B.

20. **Congruence of Line Segements :-** Two line segments AB and CD are congruent if the trace-copy of one can be superposed on the other so as to cover it completely and exactly.

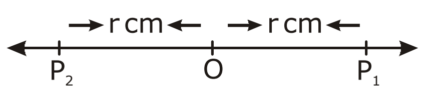
21. **Line Segment Length Axiom :-** Every line segment has a length. It is measured in terms of 'metre' or its parts.

22. **Congruent Line Segment Length Axiom :-** Two congruent line segments have equal length and conversely, two line segments of equal length are congruent, i.e. $AB \cong CD \Leftrightarrow l(AB) = l(CD)$.

23. **Line Segment Addition Axiom :-** If C is any interior point of a line segment AB, then
$l\,(AB) = l\,(AC) + l\,(CB)$

24. **Line Segment Construction Axiom :-** Given a point O on a line l and a positive real number r, there are exactly two points P_1 and P_2 on l, on either side of O such that

$$l\,(OP_1) = l\,(OP_2) = r \text{ cm}$$



25. **Distance Between Two Points :** The distance between two points P and Q is the length of the line segment joining them and it is denoted by PQ.

26. **Betweeness :-** A point C is said to lie between the two points A and B, if

(i) A, B and C are collinear points and

(ii) AC + CB = AB.

27. **Mid-point of a Line Segment :-** Given a line segment AB, a point M is said to be the mid-point of AB, if M is an interior point of AB and AM = MB.

A line through M, other than line AB is called the bisector of the segment AB.

28. **Opposite Rays :-** Two rays AB and AC are said to be opposite rays if they are collinear and point A is the only common point of the two rays.

29. Two rays or two line segments or a line segment and a ray (line) are said to be parallel if the lines containing them are parallel.

30. Euclid's Five Postulates :-

(i) A straight line may be drawn from any one point to any other point.

(ii) A terminated line can be produced indefinitely.

(iii) A circle can be drawn with any centre and any radius.

(iv) All right angles are equal to one another.

(v) If a straight line falling on two straight lines makes the interior angles on the same side of it taken together less than two right angles, then the two straight lines, if produced indefinitely, meet on that side on which the angles are less than two right angles.

31. Some of Euclid's axioms :-

(i) Things which are equal to the same thing are equal to one another

(ii) If equals are added to equals, the wholes are equal.

(iii) If equal are subtracted from equals, the remainders are equal.

(iv) Things which coincide with one another are equal to one another.

(v) The whole is greater than the part.

(vi) Things which are double of the same things are equal to one another.

(vii) Things which are halves of the same things are equal to one another.

32. A system of axioms is called consistent, if it is impossible to deduce from these axioms a statement that contradicts any axioms or previously proved statement.

IMPORTANT POINTS

- A solid has shape, size, position and can be moved from one place to another, its boundaries are called surfaces.
- The boundaries of the surfaces are curves or straight line and these lines end in points.
- A point is that which has no part.
- A line is breadthless length.
- The ends of a line are points
- A straight line is a line which lies evently with the points on itself.
- A surface is that which has length and breadth only. The edges of a surface are lines.
- A plane surface is a surface which lies evently with the straight lines on itself.
- The assumptions that were specific to geometry are called 'postulate'.
- Common notion, often called 'axioms', were assumptions used throughout mathematics and not specifically linked to geometry.
- An equilateral triangle can be constructed on any given line segment
- Two distinct lines cannot have more than one point in common.
- Two distinct intersecting lines cannot be parallel to the same line.

SOLVED PROBLEMS

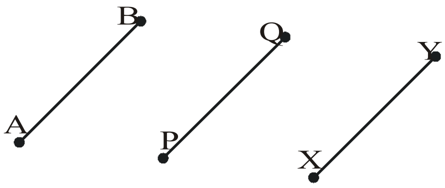
Ex.1 Which of the following statement are true and which are false? Give reason for your answer.

(i) Only one line can pass through a single point.

(ii) There are an infinite number of lines which pass through two distinct points.

(iii) A terminated line can be produced indefinitely on both the sides.

(iv) If two circles are equal, then their radii are equal.



(v) In figure, if AB = PQ and PQ = XY, then AB = XY

Sol. (i) False, Since through a point infinite number of lines may be drawn.

(ii) False, Since one and only one line can pass through two distinct points.

(iii) True, Since a line segment may be produced infinitely on both the sides.

(iv) True, Since two circle will be equal only when their radii are same

(v) True, Since AB = PQ and PQ = XY, then AB = XY (By transitive property)

Ex.2 Consider two "postulates" given below :

(i) Given any two distinct points A and B, there exists a third point C which is in between A and B.

(ii) There exist at least three points that are not on the same line.

Do these postulates contain any undefind terms ? Are these postulates consistent ? Do they follow from Euclid's postulates ? Explain.

Sol. A point C is said to be between A and B, if C is an interior point of AB i.e., if

(i) A, B and C are collinear and

(ii) AC + CB = AB

(a) Undefined term is interior of AB.

(b) Yes, these are consistent.

(c) Yes, they follow from Euclid's postulates.

Ex.3 Point C is called a mid-point of line segment AB. Prove that every line segment has one and only one mid-point.

Sol. Given : C is the mid point of $\overline{AB}$ such that AC = BC.

To prove : $\overline{AB}$ has one and only mid point C.

Proff : Suppose C and C' be the two mid points of $\overline{AB}$.

$\therefore$ AC = $\frac{1}{2}$ $\overline{AB}$ and AC' = $\frac{1}{2}$ $\overline{AB}$ $\Rightarrow$ AC = AC'

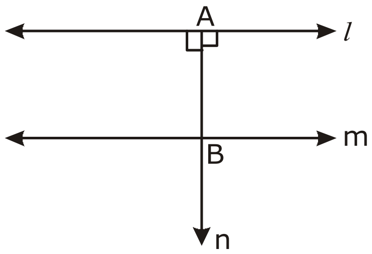
Which is possible only when C and C' coincide $\Rightarrow$ points C and C' are identical.

Hence, every line segment has one and only one mid point C.

Ex.4 How would you rewrite Euclid's fifth postulate so that it would be easier to understand ?

Sol. Two distinct intersecting lines cannot be parallel to the same line.

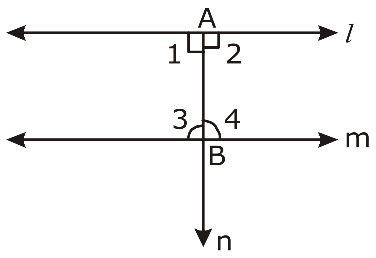
Ex.5 Line l is parallel to line m. A line n which is perpendicular to line l at A is also perpendicular to the line m at B.



Sol. We are given that $l \parallel m$ and line n is perpendicular to line l at A.

Now $\angle 1$ and $\angle 2$ = 1 rt. angle

Now, n meets m at B.



Let if possible n is not perpendicular to m to at B.

Then, either $\angle 3$ or $\angle 4$ is less than 1 right angle.

Let us take $\angle 3$ less than 1 right angle.

This implies $\angle 1 + \angle 3 < 2$ right angle.

Then, by Euclid's fifith postulate lines l and m intersect.

But we are given that $l \parallel m$.

Thus, our supposition is wrong.

Therefore n is perpendicular to m at B.

Ex.6 If C is the mid-point of the segment AB. P and Q are mid-point of the segments AC and BC respectively. Prove that AP = BQ = $\frac{1}{4}$AB.

Sol. Since C is the mid-point of the segment AB.

$\Rightarrow \quad AC = \frac{1}{2}AB$

Now, P is mid-point of segment AC.

$\Rightarrow \quad AP = \frac{1}{2}AC$

From (1) and (2), we get

$$AP = \frac{1}{2}\left\{\frac{1}{2}AB\right\} = \frac{1}{4}AB$$

Similarly, we have

$$BC = \frac{1}{2}AB \text{ and } BQ = \frac{1}{2}BC$$

$$\Rightarrow \quad BQ = \frac{1}{2}\left\{\frac{1}{2}AB\right\} = \frac{1}{4}AB$$

Therefore, we have,

$$AP = BQ = \frac{1}{4}AB.$$

Ex.7 If AD = BC. Prove that AC = BD.

Sol. We have , AD = BC

$\Rightarrow$ AC + CD = BD + CD

By the application of Euclid's axiom (3) when we subtract CD from both sides of (1), the remainders on both sides of (1) are equal.

i.e., AC = BD

Ex.8 Prove that an equilateral triangle can be constructed on any given line segment.

Sol. Let AB be any given line segment and we have to construct an equilateral triangle with this line segment as one side of triangle.

According to Euclid's postulate (P-3) a circle can be drawn with any radius and any centre. So let us draw with any radius and any centre. So let us draw a circular arc with A as centre and AB as radius. Then we draw another circular arc with B as centre and BA as radius, intersecting the previous arc at C.

Join CA and CB. Now is ΔABC, we observe AB = AC

($\because$ both are radii of the same circle).

Similarly AB = BC ($\because$ both are radii of the same circle).

$\therefore$ AB = AC = BC

So ΔABC is an equilateral triangle.

Ex.9 Two salesman make equal sales during the month of August. In September, each salesman doubles his sale of the month of August. Compare their sales in September.

Sol. Let Rs. x be the sales of each salesman during the month of August. In September, it will be 2x for each. According to Euclid's Sixth axiom, the things which are double of equals are equal to each other. So sales of both the salesman will be equal in the month of September.

EXERCISE - I | UNSOLVED PROBLEM

FILL IN THE BLANKS

Q.1 Axioms or postulates are the .... which are obvious universal truths.

Q.2 If equals are added to ...., the wholes are equal.

Q.3 If equals are subtracted from equals the ...... are equal.

Q.4 All .... angles are equal to one another.

Q.5 There are an .... of lines which pass through two distinct points.

Q.6 Two distinct lines can not have more than .... point in common.

Q.7 A .... is that which has no part.

Q.8 The .... of a line are ....

Q.9 The whole is .... the part.

Q.10 Things which are .... of the same things are equal to one another.

Q.11 The assumptions that were specific to geometry are called ....

Q.12 Two distinct intersecting lines cannot be .... to the same line.

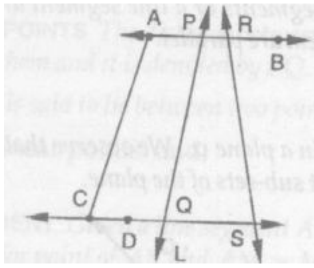
Q.13 Define the following terms:
(i) Line segment
(ii) Collinear points
(iii) Parallel lines
(iv) Intersecting lines
(v) Concurrent lines
(vi) Ray
(vii) Half-line

Q.14 (i) How many lines can pass through a given point?
(ii) In how many points can two distinct lines at the most intersect?

Q.15 (i) Given two points P and Q, find how many lines segments do they determine.
(ii) Name the line segments determined by the three collinear points P, Q and R.

Q.16 Write the truth value (T/F) of each of the following statements:
(i) Two lines intersect in a point.
(ii)Two lines may intersect in two points.
(iii) A segment has no length.
(iv)Two distinct points always determine a line
(v) Every ray has a finite length.
(vi) A ray has one end-point only.
(vii) A segment has one end-point only.
(viii) The ray AB is same as ray BA.
(ix) Only a single line may pass through a given point.
(x) Two lines are coincident if they have only one point in common.

Q.17 In fig. 9.17, name the following:



(i) Five line segments.
(ii) Five rays.
(iii) Four collinear points.
(iv) Two pairs of non-intersecting line segments.

Q.18 Fill in the blanks so as to make the following statements true:
(i) Two distinct points in a plane determine a ________ line.
(ii) Two distinct ________ in a plane cannot have more than one point in common.
(iii) Given a line and a point, not on the line, there is one and only ________ line which passes through the given point and is _______ to the given line.
(iv) A line separates a plane into ________ parts namely the ________ and the ________ itself.

ANSWER KEY

1.assumptions **2.** equals
3.remainders **4.** right **5.** infinite number
6.one **7.** point **8.** ends, points
9. greater than **10.**halves or double
11. postulate **12.** parallel
14. (i) Infinitely many (ii) One
15. (i) One (ii) PQ,QR, PR
16. (i) F (ii) F (iii) F (iv)T (v) F (vi) T (vii) F (viii) F (ix) F (x) F
18. (i) unique (ii) lines
(iii) perpendicular, perpendicular
(iv) three, two half planes, line.

EXERCISE – II | SCHOOL EXAM/BOARD

Q.1 Define the following terms:

(i) Line segment **(ii)** Collinear points

(iii) Parallel lines **(iv)** Intersecting lines

(v) Concurrent lines **(vi)** Ray

Q.2 **(i)** How many lines can pass through a given point?

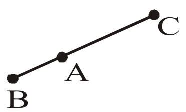
(ii) In how many points can two distinct lines at the most intersect?

Q.3 **(i)** Given two points P and Q, find how many lines segments do they determine.

(ii) Name the lines segments determined by the three collinear points P, Q and R

Q.4 A, B and C are three collinear points such that point A lies between B and C.

Name all the line segments determined by these points and write the relation between them.



Q.5 Name three undefined terms.

Q.6 If AB is a line and P is a fixed point, outside AB, how many lines can be drawn through P which are:

(i) Parallel to AB

(ii) Not parallel to AB.

Q.7 Out of the three lines AB, CD and EF, if AB is parallel to EF and CD is also parallel to EF, then what is the relation between AB and CD.

Q.8 **(i)** How many lines can be drawn to pass through three given points if they are not collinear?

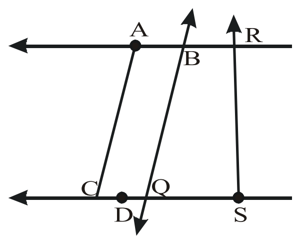
(ii) How many line segments can be drawn to pass through two given points if they are collinear?

Q.9 Two lines which are both parallel to the same line, are parallel to each other. Prove the theorem.

Q.10 Two distinct lines cannot have more than one point in common. Prove the theorem.

Q.11 If B lies between A and C, AC = 15 cm and BC = 9 cm. What is AB^2 ?

Q.12 In figure name the following :



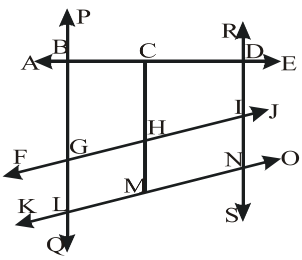
(i) Five line segments

(ii) Five rays

(iii) Four collinear points

(iv) Two pairs of non-intersecting line segments

Q.13 In the figure name the following



(i) Five rays,

(ii) Five line segments,

(iii) Two pairs of non-intersecting line segment.

A, B, C, D and E are collinear points.

Q.14 In figure, is mid-point of the line segment AB.

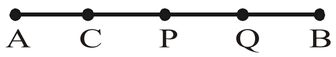
D and E are mid-points of the segments AC and BC respectively.

Prove that :

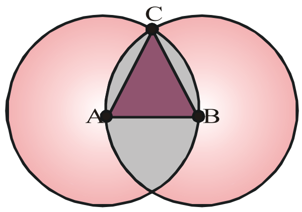
(i) AB = 4.AD (ii) AB = 4.BE.

Q.15 In figure, AC = PQ and CP = BQ

Prove that P is mid-point of the line segment AB.



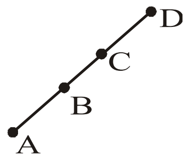
Q.16 In figure A and B are the centres of the two intersecting circles.



With the help of Euclid's first axiom, prove that, the ΔABC is an equilateral triangle.

Q.17 If A, B and C are three points on a line, and B lies between A and C, then prove that: AB + BC =AC.

Q.18 In the given figure, if AB = CD ; prove that: AC = BD.



ANSWER KEY

2. **(i)** Infinitely many **(ii)** Only one

3. **(i)** One **(ii)** PQ, QR, PR

4. BA, AC & BC ; BA + AC = BC

5. Point, line and plane

6. **(i)** Only one, **(ii)** Infinite **7.** AB $\parallel$ CD

8. **(i)** Three lines **(ii)** one

11. 36 cm

12. (i) $\overline{AB}, \overline{AC}, \overline{CQ}, \overline{BR}, \overline{RS}$ (ii) $\overrightarrow{BQ}, \overrightarrow{BA}, \overrightarrow{BR}, \overrightarrow{QC}, \overrightarrow{QS}$,

(iii) C, D, Q, S (iv) AC, BQ and QS, AB

13. (i) AD, FJ, KO, PQ, RS

(ii) ND, GI, LN, BL, CM

(iii) GI, LN and BL, DN

EXERCISE – III OLYMPIAD QUESTIONS

Q.1 In ancient India, the shapes of altars used for household riturals were
(A) squares and circles
(B) rectangles and square
(C) triangles and rectangles
(D) trapeziums and pyramids

Q.2 The number of interwoven triangles in Sriyantra is
(A) 11 (B) 9
(C) 8 (D) 7

Q.3 Thales belongs to the country
(A) Babylonia (B) Egypt
(C) Greece (D) Rome

Q.4 Euclid belongs to the country
(A) India (B) Greece
(C) Egypt (D) Babylonia

Q.5 Pythagoras was a student of
(A) Thales (B) Euclid
(C) Arhimedes (D) None of these

Q.6 In Indus Valley Civilisation (about 300 BC) the bricks used for construction work were having dimensions in the ratio
(A) 4 : 3 : 1 (B) 4 : 2 : 1
(C) 4 : 3 : 2 (D) 4 : 4 : 1

Q.7 Which of the following needs a proof?
(A) an axiom (B) a definition
(C) a postulate (D) a theorem

Q.8 Axioms are assumed
(A) definitions (B) theorems
(C) universal truths in all branches of mathematics
(D) universal truths specific to geometry

Q.9 'Lines are parallel if they do not intersect' is stated in the form of
(A) an axiom (B) a definition
(C) a postulate (D) a theorem

Q.10 Euclid stated that 'all right angles are equal to each other', in the form of
(A) an axiom (B) a definition
(C) a postulate (D) a proof

Q.11 Greeks emphasised on
(A) inductive reasoning
(B) deductive reasoning
(C) practical use of geometry
(D) analytical geometry

Q.12 A soild has
(A) 0 dimension (B) 1 dimension
(C) 2 dimension (D) 3 dimension

Q.13 A surface has
(A) 0 dimension (B) 1 dimension
(C) 2 dimension (D) 3 dimension

Q.14 A point has
(A) 0 dimension (B) 1 dimension
(C) 2 dimension (D) 3 dimension

Q.15 Boundaries of solids are
(A) lines (B) curves
(C) surfaces (D) points

Q.16 Boundaries of surfaces are
(A) lines (B) curves
(C) points (D) none of these

Q.17 The side faces of a pyramid are
(A) triangles (B) squares
(C) trapeziums (D) polygons

Q.18 The base of a pyramid is
(A) a triangle only (B) a square only
(C) a rectangle only (D) any polygon

Q.19 The number of planes passing through three non-collinear points is
(A) 2 (B) 3
(C) 4 (D) 1

Q.20 Euclid divided his book 'Elements' into how many chapters?
(A) 9 (B) 11
(C) 12 (D) 13

Q.21 Which of the following is a true statement?
(A) Only a unique line can be drawn to pass through a given point
(B) Only a unique line can be drawn to pass through three given points
(C) If two circles are equal, then their radii are equal
(D) A line has a definite length.

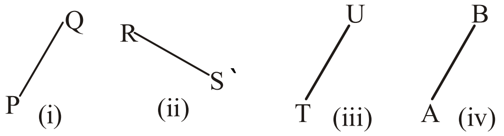
Q.22 Which of the following is a false statement?
(A) An infinite number of lines can be drawn to pass through a given point.
(B) A unique line can be drawn to pass through two given points.
(C) Ray $\overrightarrow{AB}$ = ray $\overrightarrow{BA}$.
(D) A ray has one end point.

Q.23 Given two distinct points, there are so many lines that passes through them -
(A) True
(B) False
(C) Can not be obtained
(D) None of these

Q.24 When any system of axioms is given, it needs to be ensured that the system is consistent -
(A) True (B) False
(C) Does not exist (D) None of these

Q.25 If P, Q and R are three points on a line, and Q lies between P and R, then -
(A) PQ + QR = PR (B) PR + RQ = PQ
(C) RP + QR = PQ (D) None of these

Q.26 Which of the following lines are parallel

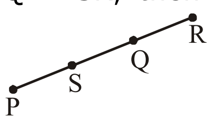


(A) (i) and (ii) (B) (ii) and (iii)
(C) (i), (ii) and (iii) (D) (i), (iii) and (iv)

Q.27 Theorems are statements which are proved, using definitions, axioms, previously proved statements and deductive reasoning -
(A) Yes (B) No
(C) Does not exist (D) None of these

Q.28 If a point Q lies between two points P and R such that PQ = QR, then point Q is called-
(A) Mid point (B) Line segment
(C) Segment point (D) None of these

Q.29 In fig. if PQ = SR, then -



(A) PS = SR (B) PQ $\neq$ SR
(C) PQ = QR (D) PS = QR

Q.30 Every line segment has one and only one mid-point -
(A) True (B) False
(C) Un predictable (D) None of these

Q.31 An angle is formed when two rays originate from the same end point -
(A) True (B) False
(C) Un predictable (D) None of these

Q.32 A part of a line with two end points is called a -
(A) line-segment
(B) segment
(C) point segment
(D) None of these

Q.33 A part of a line with one end point is called a -
(A) line (B) ray
(C) line segment (D) None of these

Q.34 If three or more points lie on the same line, they are called collinear points
(A) True (B) False
(C) Un predictable (D) None of these

Q.35 If three or more points are not lie on the same line, they are called non-collinear points -
(A) True (B) False
(C) Un predictable (D) None of these

Q.36 A circle can be drawn with any centre and any radius -
(A) True (B) False
(C) Does not exist (D) None of these

Q.37 A straight line may not be drawn from any one point to any other point -
(A) True (B) False
(C) Un predictable (D) None of these

Q.38 A terminated line can not be produced indefinitely on both the sides -
(A) True (B) False
(C) Un predictable (D) None of these

Q.39 If two circles are equal, then their radii are equal-
(A) True
(B) False
(C) Can not be obtained
(D) None of these

Q.40 The distance of a point from a line is the length of the perpendicular from the point to the line-
(A) True
(B) False
(C) Can not be obtained
(D) None of these

Q.41 The Euclidean geometry is valid only for the figures in the plane -
(A) True
(B) False
(C) Un predictable
(D) None of these

Q.42 Things which concide with one another are–
(A) not equal to one another
(B) equal to one another
(C) identical to one another
(D) None of these

Q.43 Axioms or postulates are the .... which are obvious universal truths.

Q.44 If equals are added to ...., the wholes are equal.

Q.45 If equals are subtracted from equals the ...... are equal.

Q.46 All .... angles are equal to one another.

Q.47 There are an .... of lines which pass through two distinct points.

Q.48 Two distinct lines can not have more than .... point in common.

Q.49 A .... is that which has no part.

Q.50 The .... of a line are ....

Q.51 The whole is .... the part.

Q.52 Things which are .... of the same things are equal to one another.

Q.53 The assumptions that were specific to geometry are called ....

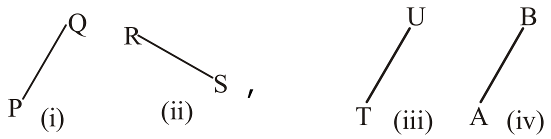
Q.54 Two distinct intersecting lines cannot be .... to the same line.

Q.55 Given two distinct points, there are so many lines that passes through them -
(A) True
(B) False
(C) Can not be obtained
(D) None of these

Q.56 When any system of axioms is given, it needs to be ensured that the system is consistent -
(A) True (B) False
(C) Does not exist (D) None of these

Q.57 If P, Q and R are three points on a line, and Q lies between P and R, then -
(A) PQ + QR = PR (B) PR + RQ = PQ
(C) RP + QR = PQ (D) None of these

Q.58 Which of the following lines are parallel?

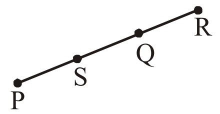


(A) (i) and (ii) (B) (ii) and (iii)
(C) (i), (ii) and (iii) (D) (i), (iii) and (iv)

Q.59 Theorems are statements which are proved, using definitions, axioms, previously proved statements and deductive reasoning -
(A) Yes (B) No
(C) Does not exist (D) None of these

Q.60 If a point Q lies between two points P and R such that PQ = QR, then point Q is called
(A) Mid point (B) Line segment
(C) Segment point (D) None of these

Q.61 In fig. if PQ = SR, then -



(A) PS = SR (B) PQ $\neq$ SR
(C) PQ = QR (D) PS = QR

Q.62 Every line segment has one and only one mid-point -
(A) True (B) False
(C) Un predictable (D) None of these

Q.63 An angle is formed when two rays originate from the same end point -
(A) True (B) False
(C) Un predictable (D) None of these

Q.64 A part of a line with two end points is called a -
(A) line-segment (B) segment
(C) point segment (D) None of these

Q.65 A part of a line with one end point is called a -
(A) line (B) ray
(C) line segment (D) None of these

Q.66 If three or more points lie on the same line, they are called collinear points -
(A) True (B) False
(C) Un predictable (D) None of these

Q.67 If three or more points are not lie on the same line, they are called non-collinear points -
(A) True (B) False
(C) Un predictable (D) None of these

Q.68 A circle can be drawn with any centre and any radius -
(A) True (B) False
(C) Does not exist (D) None of these

Q.69 A straight line may not be drawn from any one point to any other point -
(A) True (B) False
(C) Un predictable (D) None of these

Q.70 A terminated line can not be produced indefinitely on both the sides -
(A) True (B) False
(C) Un predictable (D) None of these

Q.71 If two circles are equal, then their radii are equal-
(A) True
(B) False
(C) Can not be obtained
(D) None of these

Q.72 The distance of a point from a line is the length of the perpendicular from the point to the line-
(A) True
(B) False
(C) Can not be obtained
(D) None of these

Q.73 The Euclidean geometry is valid only for the figures in the plane -
(A) True (B) False
(C) Un predictable (D) None of these

Q.74 Things which concide with one another are–
(A) not equal to one another
(B) equal to one another
(C) identical to one another
(D) None of these

ANSWER KEY

1.	A	**2.**	B	**3.**	C	**4.**	B
5.	A	**6.**	B	**7.**	D	**8.**	C
9.	B	**10.**	A	**11.**	B	**12.**	D
13.	C	**14.**	A	**15.**	C	**16.**	B
17.	A	**18.**	D	**19.**	D	**20.**	D
21.	C	**22.**	C	**23.**	B	**24.**	A
25.	A	**26.**	D	**27.**	A	**28.**	A
29.	D	**30.**	A	**31.**	A	**32.**	A
33.	B	**34.**	A	**35.**	A	**36.**	A
37.	B	**38.**	B	**39.**	A	**40.**	A
41.	A	**42.**	B	**43.**	assumptions		
44.	equals	**45.**	remainders			**46.**	right
47.	infinite number			**48.**	one		
49.	point	**50.**	ends, points				
51.	greater than	**52.**	halves or double				
53.	postulate			**54.**	infinite		
55.	B	**56.**	A	**57.**	A	**58.**	D
59.	A	**60.**	A	**61.**	D	**62.**	A
63.	A	**64.**	A	**65.**	B	**66.**	A
67.	A	**68.**	A	**69.**	B	**70.**	B
71.	A	**72.**	A	**73.**	A	**74.**	B

LINES AND ANGLES

1. Two angles are called adjacent angles if
(i) they have the same vertex
(ii) they have a common arm and
(iii) uncommon arms are on either side of the common arm.

2. Two adjacent angles are said to form a linear pair of angles, if their non-common arms are two opposite rays.

3. The sum of all the angles round a point is equal to 360^o.

4. If two lines intersect, then the vertically opposite angles are equal.

5. A line which intersects two or more given lines at distinct points, is called **transversal** of the lines.

6. Two angles on the same side of a transversal are known as **corresponding angles** if both lie either above the two lines or below the two lines.

7. The pairs of interior angles on the same side of the transversal are called **consecutive interior** angles.

8. If a transversal intersects two parallel lines, then each pair of **corresponding angle are equal**.

9. If a transversal intersect two parallel lines, then each pair of **alternate interior angles are equal.**

10. If a transversal intersect two parallel lines, then each pair of **consecutive interior angles** are **supplementary**.

11. A triangle whose sides are unequal is called a **scalene triangle**.

12. A triangle, two of whose sides are equal in length is called an **isosceles triangle**.

13. A triangle, all of whose sides are equal is called an **equilateral triangle**.

14. A triangle, each of whose angle is acute, is called an **acute triangle.**

15. A triangle with one angle a right angle is called a **right triangle.**

16. A triangle with one angle an obtuse angle is known as an **obtuse triangle.**

17. If a side of a triangle is produced, the exterior angle so formed is equal to the sum of two interior opposite angles.

18. If all sides of a polygon are equal, it is called a **regular polygon.**

19. Sum of all the interior angles of a polygon of n sides = $(n - 2) \times 180^o$ $(n \geq 3)$

20. Each interior angle of a regular polygon on n sides $= \dfrac{(n-2) \times 180^o}{n}$

21. Sum of all the exterior angles formed by producing the sides of polygon = 360^o

22. Number of sides of poly-gon
$$= \frac{360^o}{180^o - \text{each interior angle}}$$

SOLVED PROBLEMS

Ex.1 Find the angle which is complement of itself.

Sol. [Hint : Let the required angle be x°. Its complementary angle = x°.
$\therefore$ x° + x° = 90°] [Ans. 45°]

Ex.2 An angle is equal to five times its complement. Determine its measure.

Sol. [Hint : x° = 5 (90 – x)°] [Ans. 75°]

Ex.3 An angle is 20° less than its complement. Find its measure.

Sol. [Hint : x° = (90 – x)° –20°] [Ans. 35°]

Ex.4 Find the angle which is supplementary of itself.

Sol. [Hint : x° + x° = 180°] [Ans. 90°]

Ex.5 Two supplementary angles differ by 34°. Find the angles.

Sol. Let one angle be x°. Then, the other angle is (x + 34)°.

$\therefore$ x° + (x + 34)° = 180°

$\Rightarrow$ 2x° + 34° = 180°

$\Rightarrow$ 2x° = 180° – 34° $\Rightarrow$ 2x° = 146°

$\Rightarrow$ x = 73°.

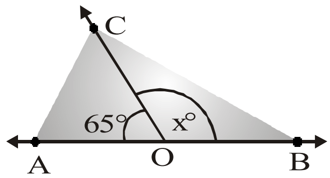
Thus, two angles are of measure 73° and 73° + 34° = 107°.

Ex.6 An angle is equal to one-third of its supplement. Find its measure.

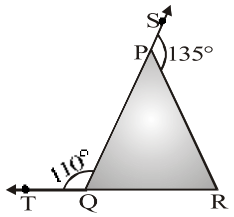
Sol. [Hint : x° = $\frac{1}{3}$ (180 – x)°] [Ans. 45°]

Ex.7 In the adjoining figure, AOB is a straight line. Find the value of x.

Sol. [Hint : $\angle$AOC + $\angle$BOC = 180°] [Ans. 115°]



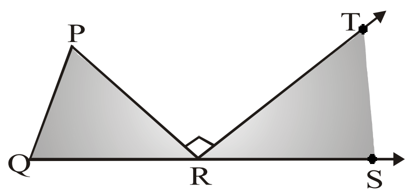
Ex.8 In fig, sides QP and RQ of ΔPQR are produced to points S and T respectively. If $\angle$SPR = 135° and $\angle$PQT = 110°, find $\angle$PRQ.



Sol. [Hint : $\angle$PQT + $\angle$PQR = 180° [Linear pair of angles]
$\angle$PQR + $\angle$PRQ = 135°] [Ans. $\angle$PRQ = 65°]

Ex.9 In fig, side QR of ΔPQR has been produced to S. If $\angle$P : $\angle$Q : $\angle$R = 3 : 2 : 1 and RT $\perp$ PR, find $\angle$TRS.

Sol. In ΔPQR,



$\angle$P + $\angle$Q + $\angle$R = 180°

[$\because$ The sum of the angles of a triangle is 180°]

$\angle$P : $\angle$Q : $\angle$R = 3 : 2 : 1 [Given]

Sum of the ratios = 3 + 2 + 1 = 6

$\therefore$ $\angle$R = $\frac{1}{6}\times$180° = 30°

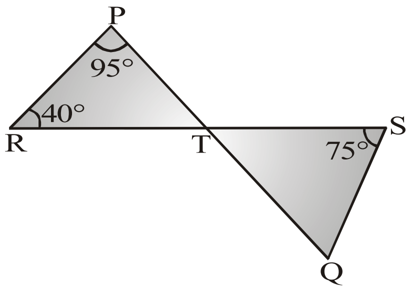
Now, $\angle$PRQ + $\angle$PRT + $\angle$TRS = 180° [Linear pair of angles]

$\Rightarrow$ 30° + 90° + $\angle$TRS = 180°

$\Rightarrow$ 120° + $\angle$TRS = 180°

$\Rightarrow$ $\angle$TRS = 180° – 120° = 60°

Ex.10 In fig, if line PQ and RS intersect at point T, such that $\angle PRT = 40°$, $\angle RPT = 95°$ and $\angle TSQ = 75°$, find $\angle SQT$.



Sol. In ΔPRT,

$\angle PTR + \angle PRT + \angle RPT = 180°$

[∵ The sum of the angles of a triangle is 180°]

$\Rightarrow \angle PTR + 40° + 95° = 180°$

$\Rightarrow \angle PTR + 135° = 180°$

$\Rightarrow \angle PTR = 180° - 135°$

$\Rightarrow \angle PTR = 45°$

$\Rightarrow \angle QTS = \angle PTR = 45°$

[Vertically Opposite angles]

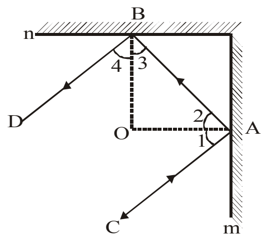
In ΔTSQ, $\angle QTS + \angle TSQ + \angle SQT = 180°$ [∵ The sum of the angles of a triangle is 180°]

$\Rightarrow 45° + 75° + \angle SQT = 180°$

$\Rightarrow 120° + \angle SQT = 180°$

$\Rightarrow \angle SQT = 180° - 120° = 60°$.

Ex.11 In fig, m and n are two plane mirrors perpendicular to each other.



Prove that the incident ray CA is parallel to reflected ray BD.

Sol. Given : Two plane mirrors m and n, perpendicular to each other.

CA is incident ray and BD is reflected ray.

To Prove : CA ∥ DB

Construction : OA and OB are perpendiculars to m and n respectively.

Proof:

Since $m \perp n$, $OA \perp m$ and $OB \perp n$

$\therefore \angle AOB = 90°$

[∵ Lines perpendicular to two perpendicular lines are also perpendicular]

Now In ΔAOB, $\angle AOB + \angle OAB + \angle OBA = 180°$ [∵ The sum of the angles of a triangle is 180°]

$\Rightarrow 90° + \angle 2 + \angle 3 = 180°$

$\Rightarrow \angle 2 + \angle 3 = 90° \Rightarrow 2(\angle 2 + \angle 3) = 180°$ Multiplying both sides by 2.

$\Rightarrow 2(\angle 2) + 2(\angle 3) = 180°$

$\Rightarrow \angle CAB + \angle ABD = 180°$

Angle of incidence = Angle of reflection

$\therefore \angle 1 = \angle 2$ and $\angle 3 = \angle 4$

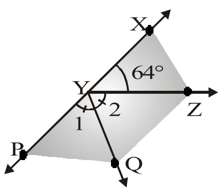
$\Rightarrow 2\angle 2 = \angle CAB$ and $2\angle 3 = \angle ABD$

$\Rightarrow \therefore CA \parallel BD$ [∵ $\angle CAB$ & $\angle ABD$ form a pair of consecutive interior angles and are supplementary]

Hence, proved.

Ex.12 It is given that $\angle XYZ = 64°$ and XY is produced to point P. Draw a figure from the given information. If ray YQ bisects $\angle ZYP$, find $\angle XYQ$ and reflex $\angle QYP$.

Sol. [Hint : $\angle 1 + \angle 2 + 64° = 180°$

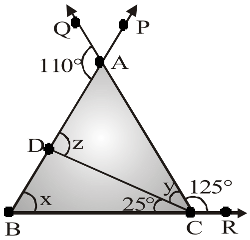


$\Rightarrow \angle 2 + \angle 2 + 64° = 180°$

and reflex $\angle QYP = 180° + 64° + \angle 2$]

[Ans. 122°, 302°]

Ex.13 In fig. sides BA, CA and BC are produced to points P, Q and R respectively.

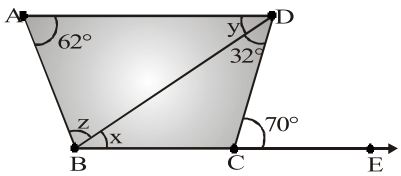


Line CD meets BA at D such that ∠BCD = 25°. If ∠BAQ = 110° and ∠ACR = 125°, then find x, y and z.

Sol. [Hint : y + 25° + 125° = 180°; z + y = 110°, x + 25° = z] [Ans. x = 55°, y = 30°, z = 80°]

Ex.14 In fig. if AD||BC, ∠BAD = 62°, ∠BDC = 32° and ∠DCE = 70°, then find x, y and z.

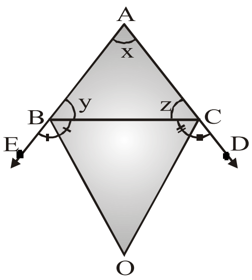
Sol. [Hint : x + 32° = 70°; x = y
(Alternate interior angles);
y + z + 62° = 180°]



[Ans. x = 38°, y = 38°, z = 80°]

Ex.15 In fig, the sides AB and AC of ΔABC are produced to point E and D respectively. If bisectors BO and CO of ∠C BE and ∠BCD respectively meet at point O, then prove that ∠BOC = 90° – $\frac{1}{2}$∠BAC.

Sol. Given : In fig. AB and AC of ΔABC are produced to points E and D respectively.



BO and CO are bisectors of ∠CBE and ∠BCD respectively.

To Prove : ∠BOC = 90° – $\frac{1}{2}$∠BAC.

Proof:

∠CBO = $\frac{1}{2}$∠CBE [∵ OB bisects ∠CBE]

= $\frac{1}{2}$(180°– y)

[∵∠CBE + y = 180°, Linear pair of angles]

= 90° – $\frac{y}{2}$ .... (1)

and ∠BCO = $\frac{1}{2}$∠BCD [∵OC bisects ∠BCD] = $\frac{1}{2}$(180°– z)

[$\because \angle BCD + z = 180°$, Linear pair of angles]

$= 90° - \frac{z}{2}$ .... (2)

Now In ΔBOC, $\angle BOC + \angle CBO + \angle BCO = 180°$ [$\because$Angle sum property of a triangle]

$\angle BOC + 90° - \frac{y}{2} + 90° - \frac{z}{2} = 180°$ Using (1) and (2)

$\Rightarrow \angle BOC = \frac{z}{2} + \frac{y}{2}$

$\Rightarrow \angle BOC = \frac{1}{2}(y + z)$ .... (3)

Now $x + y + z = 180°$

[$\because$Angle sum property of a triangle]

$\Rightarrow y + z = 180° - x$ .... (4) So $\angle BOC = \frac{1}{2}(180° - x)$

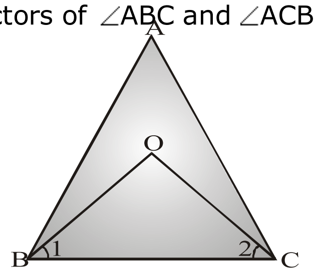
From (3) and (4)

$\Rightarrow \angle BOC = 90° - \frac{x}{2}$ or, $\angle BOC = 90° - \frac{1}{2}\angle BAC$

Hence, proved.

Ex.16 If the bisectors of angles $\angle ABC$ and $\angle ACB$ of a triangle ABC meet at a point O, then prove that $\angle BOC = 90° + \frac{1}{2}\angle A$.

Sol. Given : A ΔABC such that the bisectors of $\angle ABC$ and $\angle ACB$ meet at a point O respectively.



To Prove : $\angle BOC = 90° + \frac{1}{2}\angle A$.

Proof:

In ΔABC,

$\angle A + \angle B + \angle C = 180°$

[$\because$Angle sum property of a triangle]

and In ΔOBC,

$\angle 1 + \angle 2 + \angle BOC = 180°$

[$\because$Angle sum property of a triangle]

or $2\angle 1 + 2\angle 2 + 2\angle BOC = 360°$ [$\because$Multiplying both sides by 2]

or $\angle B + \angle C + 2\angle BOC = 360°$

[$\because$OB and OC are the bisector $\angle B$ and $\angle C$ respectively]

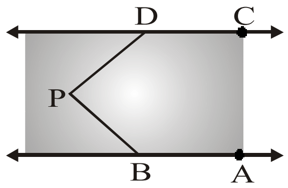
$\Rightarrow$ $(180° - \angle A + 2\angle BOC = 360°$

[$\because$Using (1), $\angle B + \angle C = 180° - \angle A$]

$\Rightarrow$ $2\angle BOC = 360° - 180° + \angle A$

$\Rightarrow$ $\angle BOC = 90° + \frac{1}{2}\angle A$. Hence, proved.

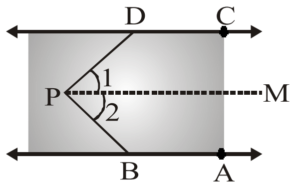
Ex.17 In the following fig. AB||CD and P is a point as shown.



Prove that $\angle ABP + \angle BPD + \angle CDP = 360°$.

Sol. [Hint : Through P draw, PM||BA]

$\angle 1 + \angle CDP = 180°$ ...(i)

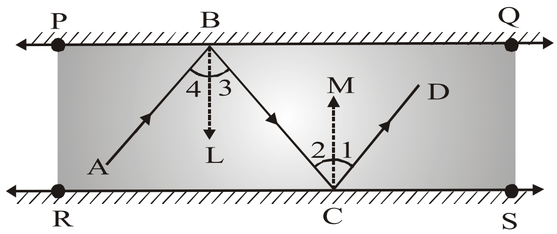


$\angle 2 + \angle ABP = 180°$...(ii)

Add (i) and (ii)]

Ex.18 In figure PQ, and RS are two mirrors placed parallel to each other. An incident ray AB strikes the mirror PQ at B, the reflected ray moves along the path BC and strikes the mirror RS at C and again reflects back along CD. Prove that AB ∥ CD.

Sol. Given : In figure PQ, and RS are two mirrors placed



parallel to each other. AB is incident ray and CD is reflected ray.

To Prove : AB ∥ CD.

Construction : Draw perpendiculars at A and B to the two plane mirrors.

Proof:

Since BL ⊥ PQ, CM ⊥ RS and PQ||RS

∴ BL||CM

and ⇒ $\angle 2 = \angle 3$

[∵Alternate interior angles]

⇒ $2\angle 2 = 2\angle 3$

[∵Multiplying both sides by 2]

⇒ $\angle BCD = \angle ABC$

Acc. to By law of reflection,

Angle of incidence = Angle of reflection,

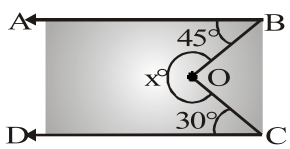
∴ $\angle 1 = \angle 2$ and $\angle 3 = \angle 4$.

So, AB||CD

[∵$\angle ABC$ & $\angle BCD$ form a pair of alternate interior angles and are equal]

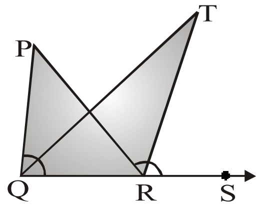
Hence, proved.

Ex.19 Find the value of x, if in fig, AB||CD.



Sol. [Hint : Through O draw, OE||AB||CD.] [Ans. 285°]

Ex.20 In a fig, the side QR of ΔPQR is produced to a point S. If the bisectors of $\angle PQR$ and $\angle PRS$ meet at point T, then prove that $\angle QTR = \frac{1}{2}\angle QPR$.



Sol. Given : In a fig, the side QR of ΔPQR is produced to a point S.
The bisectors of $\angle PQR$ and $\angle PRS$ meet at point T.

To Prove : $\angle QTR = \frac{1}{2}\angle QPR$.

Proof:

$\angle PRS = \angle PQR + \angle QPR$ ....(1) [$\because$Sum of interior opposite angles is equal to the exterior angle]

and $\angle TRS = \angle TQR + \angle QTR$ [$\because$ Sum of interior opposite angles is equal to the exterior angle]

$\Rightarrow 2\angle TRS = 2\angle TQR + 2\angle QTR$

$\Rightarrow \angle PRS = \angle PQR + 2\angle QTR$ ....(2) [$\because$OT bisects $\angle PQR$ and RT bisects $\angle PRS$]

or, $\angle PQR + \angle QPR = \angle PQR + 2\angle QTR$ [$\because$From (1) and (2)]

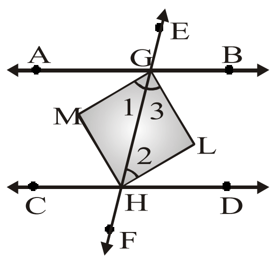
$\Rightarrow \angle QPR = 2\angle QTR$

or, $\angle QTR = \frac{1}{2}\angle QPR$

Hence, proved.

Ex.21 Prove that if two parallel lines are intersected by a transversal, then prove that the bisectors of the interior angles form a rectangle.

Sol. Given : Two parallel lines AB and CD and a transversal EF intersect them at G and H respectively. GM, HM, GL and HL are the bisectors of the two pairs of interior angles.



To Prove : GMHL is a rectangle.

Proof:

Since AB||CD

$\therefore \angle AGH = \angle DHG$

[$\because$Alternate interior angles]

$\Rightarrow \frac{1}{2}\angle AGH = \frac{1}{2}\angle DHG$

$\Rightarrow \angle 1 = \angle 2$

[$\because$GM & HL are bisectors of $\angle AGH$ and $\angle DHG$ respectively]

$\Rightarrow$ GM||HL ....(1)

[$\because\angle 1$ and $\angle 2$ from a pair of alternate interior angles and are equal]

Similarly, GL||MH

So, GMHL is a parallelogram. ....(2)

Since AB||CD

$\therefore \angle BGH + \angle DHG = 180°$

[$\because$Sum of interior angles on the same side of the transversal is 180°]

$\Rightarrow \frac{1}{2}\angle BGH + \frac{1}{2}\angle DHG = 90°$

$\Rightarrow \angle 3 + \angle 2 = 90°$ ....(3) [$\because$GL & HL are bisectors of $\angle BGH$ and $\angle DHG$ respectively]

Now, In ΔGLH,

$\angle 2 + \angle 3 + \angle L = 180°$

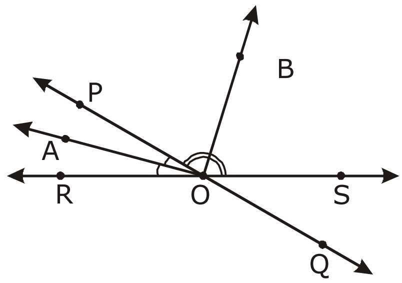
[$\because$Angle sum property of a triangle]

$\Rightarrow 90° + \angle L = 180°$ [$\because$Using (3)]

$\Rightarrow \angle L = 180° - 90°$

$\Rightarrow \angle L = 90°$ Thus, in parallelogram GMHL, $\angle L = 90°$. Hence, GMHL is a rectangle.

Ex.22 In figure line PQ and RS intersect each other at point O; ray OA and ray OB bisect $\angle POR$ and $\angle POS$ respectively. If $\angle POA : \angle POB = 2 : 7$, then find $\angle SOQ$ and $\angle BOQ$.



Sol. $\angle POR + \angle POS = 180^o$ ...(1)

We are given that, ray OA and ray OB bisect $\angle POR$ and $\angle POS$ respectively.

Therefore, $\angle POA = \frac{1}{2}\angle POR$ and $\angle POB = \frac{1}{2}\angle POS$,

$\Rightarrow \angle POA + \angle POB = \frac{1}{2}$ [POR + POS]

$= \frac{1}{2} \times 180^o = 90^o$. (by 1)

Now, if $\angle POA : \angle POB = 2 : 7$, then, we have $\angle POA = \frac{2}{9} \times 90^o = 20^o$ and $\angle POB = \frac{7}{9} \times 90^o = 70^o$

$\angle POR = 2 \times \angle POA = 2 \times 20^o = 40^o$

$\angle SOQ = \angle POR = 40^o$,

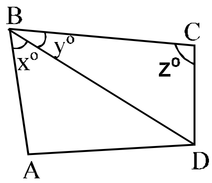
(Vertically oppositve angles)

$\therefore \angle SOQ = 40^o$; $\angle BOQ = \angle BOS + \angle SOQ$

$= \angle POB + \angle SOQ = 70^o + 40^o = 110^o$

$\therefore \angle BOQ = 110^o$

Ex.23 In figure AB || DC if $x = \frac{4}{3}y$ and $y = \frac{3}{8}z$, find the values of x, y and z.



Sol. Since AB || DC and transversal BD intersects them at B and D respectively. Therefore,

$\angle ABD = \angle CDB \Rightarrow \angle CDB = x^o$

In ΔBCD, we have

$y^o + z^o + x^o = 180^o$

$\Rightarrow \frac{3}{8}z^o + z^o + \frac{4}{3} \times \frac{3}{8}z^o = 180$

$\Rightarrow \frac{3}{8}z^o + z^o + \frac{1}{2}z^o = 180 \Rightarrow \frac{15}{8}z^o = 180^o$

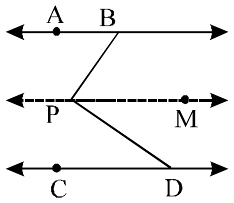
$[\because x = \frac{4}{3}y$ and $y = \frac{3}{8}z$

$\therefore x = \frac{4}{3} \times \frac{3}{8}z = \frac{z}{2}]$

$\Rightarrow z^o = 180^o \times \frac{8}{15} = 96^o$

Now, $y = \frac{3}{8}z \Rightarrow y = \frac{3}{8} \times 96^o = 36^o \times 36^o = 48$ and $x = \frac{4}{3}y \Rightarrow x = \frac{4}{3}$

Ex.24 In figure lines AB and CD are parallel and P is any point between the two lines. Prove that $\angle ABP + \angle CDP = \angle DPB$.



Sol. Through point P draw a line PM parallel to AB or CD.

Now,

PM || AB [By construction]

$\Rightarrow$ $\angle ABP = \angle MPB$ [Alternate angles] ....(i)

It is given that CD || AB and PM || AB by construction. Therefore,

PM || CD [$\because$ Lines parallel to the same line are parallel to each other]

$\Rightarrow$ $\angle CDP = \angle MPD$ [Alternate angles] ....(ii)

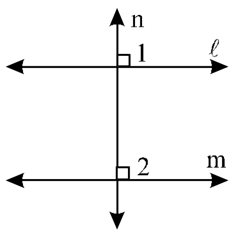
Adding (i) and (ii), we get

$\angle ABP + \angle CDP = \angle MPB + \angle MPD = \angle DPB$

Ex.25 Prove that two lines perpendicular to the same line are parallel to each other.

Sol. Let lines ℓ, m, n be such that $\ell \perp$ n and m $\perp$ n as shown in figure.

We have to prove that ℓ || m



Now,

$\ell \perp$ n and m $\perp$ n

$\Rightarrow$ $\angle 1 = 90^o$ and $\angle 2 = 90^o$

$\Rightarrow$ $\angle 1 = \angle 2$

Thus, the corresponding angles made by the transversal n with lines ℓ and m are equal.

Hence, ℓ || m.

Ex.26 Prove that two angles which have their arms parallel are either equal or supplementary.

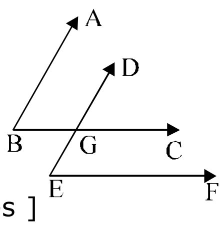
Sol. **Given :** Two angles $\angle ABC$ and $\angle DEF$ such that BA || ED and BC || EF.

To prove : $\angle ABC = \angle DEF$

or $\angle ABC + \angle DEF = 180^o$

Proof : We have the following three cases:

Case I : When both pairs of arms are parallel in the same sense fig. in this case, AB || DE and transversal BC cuts them at B and G respectively



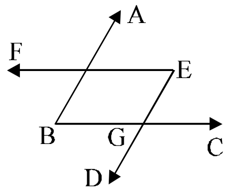
$\therefore$ $\angle ABC = \angle DGC$ [Corresponding angles] ...(i)

Again, BC || EF and transversal DE cuts them at G and E respectively.

$\therefore$ $\angle DGC = \angle DEF$ ..(ii)

From (i) and (ii), we get $\angle ABC = \angle DEF$

Case II : When both pairs of arms are parallel in opposite sense in this case,



AB || DE and transversal BC cuts them at B and G respectively.

$\therefore$ $\angle$ABC = $\angle$EGC [Corresponding angles] ...(iii)

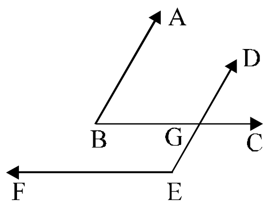
Again, BC || EF and transversal DE cuts them at G and E respectively.

$\therefore$ $\angle$DEF = $\angle$EGC [Alternate angles] ...(iv)

From (iii) and (iv), we get

$\angle$ABC = $\angle$DEF.

Case III : When one pair of arms is parallel in the same sense and the other in opposite sense. In this case,



AB || DE and transversal BC cuts them

$\therefore$ $\angle$ABC = $\angle$BGE [Alternate angles] ..(v)

Again, BC || FE and transversal DE cuts them

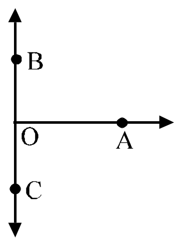
$\therefore$ $\angle$DEF + $\angle$BGE = 180º ..(vi)

[$\because$ Consecutive interior angles are supplementary]

From (v) and (vi), we get

$\angle$ABC + $\angle$DEF = 180º

Ex.27 In fig, if each of the angles AOC and AOB is a right angle show that BOC is a line.



Sol. We have,

$\angle$AOC = 90º and $\angle$AOB = 90º.

$\therefore$ $\angle$AOC + $\angle$AOB = 90º + 90º = 180º

$\Rightarrow$ $\angle$AOC and $\angle$AOB are supplementary adjacent angles.

But, two adjacent angles are a linear pair of angles if and only if they are supplementary.

Therefore, $\angle$AOC and $\angle$AOB form a linear pair of angles.

Hence, BOC is a line.

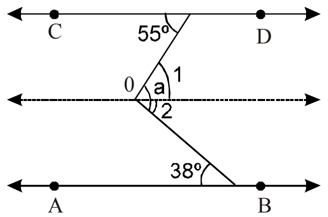
EXERCISE - I | UNSOLVED PROBLEM

Q.1 Two supplementary angles are in the ratio 2 : 3. Find the angles.

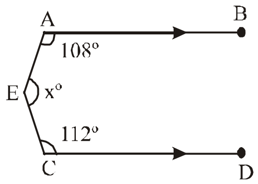
Q.2 Write the complement of the following angles $30^\circ\ 20'$

Q.3 Find the supplement of the following angles $134^\circ\ 30'\ 26''$

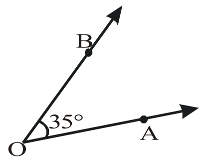
Q.4 In figure AB || CD. Determine $\angle a$



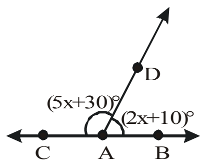
Q.5 In figure AB || CD. Find the value of x.



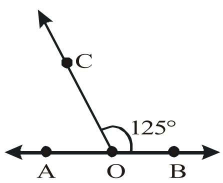
Q.6 In figure, $\angle$ AOB = 35°, find the reflex $\angle$ AOB.



Q.7 In figure, ray AD stands on the line CB, $\angle$ BAD = $(2x + 10)^\circ$ and $\angle$ CAD = $(5x + 30)^\circ$, find the value of x and also write $\angle$ BAD and $\angle$ CAD.



Q.8 In figure, ray OC stands on the line AB and $\angle$ BOC = 125°. Find reflex $\angle$ AOC.



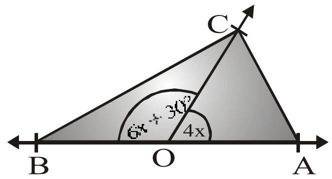
Q.9 Find the measure of the complementary angle of the following angles :
(i) 22°`   (ii) 63°

Q.10 How many degrees are there in an angle which equals two-third of its complement?

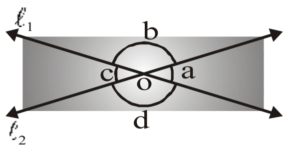
Q.11 Find the measure of the supplementary angle of the following angles :
(i) 45°`   (ii) 57°

Q.12 Two supplementary angles are in the ratio of 3 : 7. Find the angles.

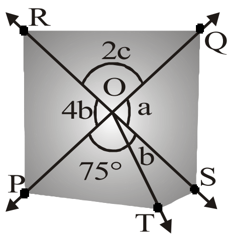
Q.13 What value of x would make AOB a line in figure, if $\angle$AOC = 4x and $\angle$BOC = $(6x + 30^\circ)$?



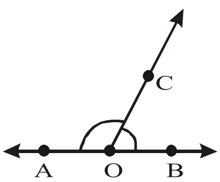
Q.14 In figure lines ℓ_1 and ℓ_2 intersect at O, forming angles as shown in the figure. If a = 35°, find the values of b, c and d.



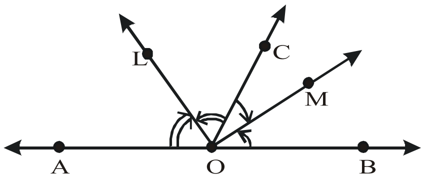
Q.15 In figure two straight lines PQ and RS intersect each other at O. If $\angle$POT = 75°, find the values of a, b and c.



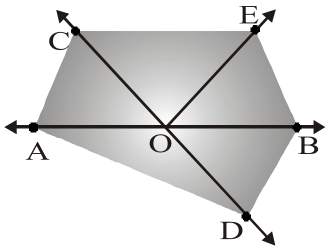
Q.16 In figure, ray OC stands on the line AB and $\angle$ BOC : $\angle$ AOC = 2 : 7. Find the angles $\angle$ AOC and $\angle$ BOC.



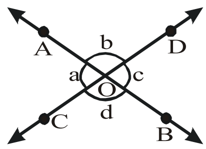
Q.17 In figure, ray OC stands on the line AB ; ray OL and ray OM are angle bisector of $\angle$ AOC and $\angle$ BOC, respectively. Prove that $\angle$ LOM = 90°.



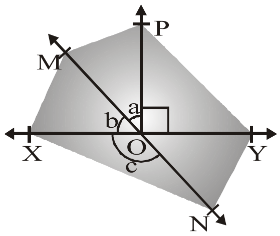
Q.18 In figure, lines AB and CD intersect at 0. If $\angle$AOC + $\angle$BOE = 70° and $\angle$BOD = 40°, find $\angle$BOE and reflex $\angle$COE.



Q.19 In figure, lines AB and CD intersect each other at point O. If a : b = 4 : 5, find a, b, c and d.



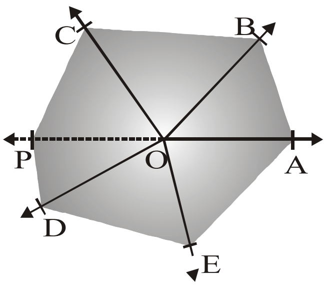
Q.20 In figure, lines XY and MN intersect at O. If $\angle$POY = 90° and a : b = 2 : 3, find c.



Q.21 Prove that the sum of all angles round a point is equal to 360°.

OR

Rays OA, OB, OC, OD and OE have the common initial point O. Show that $\angle$AOB + $\angle$BOC + $\angle$COD + $\angle$DOE + $\angle$EOA = 360°.



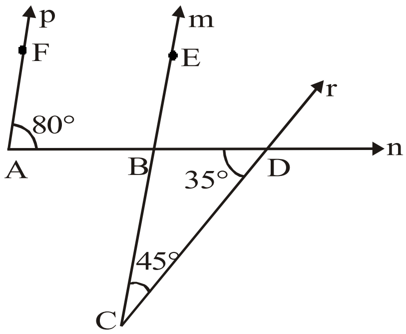
Q.22 Prove that if a ray stands on a line, then the sum of two adjacent angles so formed is 180°.

Q.23 Prove that if the sum of two adjacent angles is 180°, then the non-common arms are two opposite rays.

Q.24 In a ΔABC, $\angle$B = 105°, $\angle$C = 50°. Find $\angle$A.

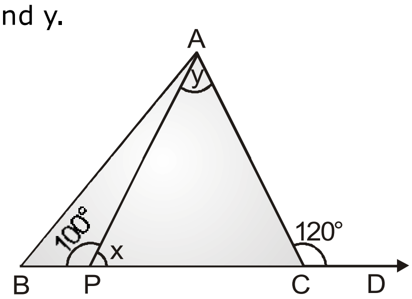
Q.25 If the angles of a triangle are in the ratio 2 : 3 : 4, determine all the angles of triangle.

Q.26 In the figure, prove that p||m.

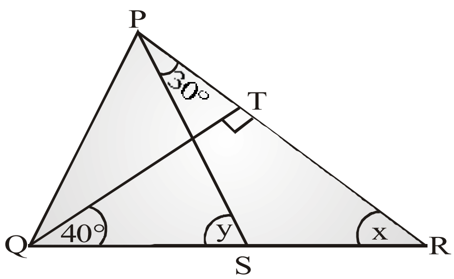


Q.27 An exterior angle of a triangle is 115° and one of the opposite angles is 35°. Find the other two angles.

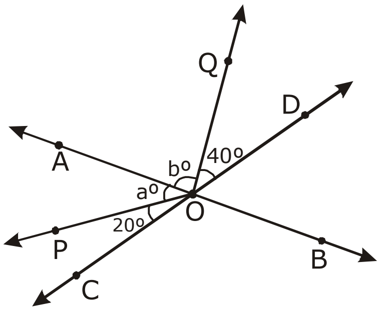
Q.28 In figure, $\angle$ACD = 120° and $\angle$APB = 100°, find x and y.



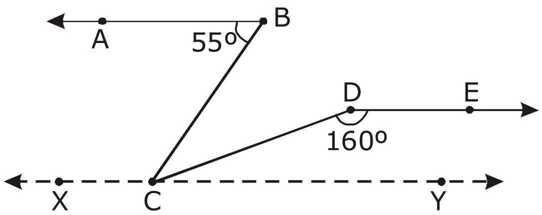
Q.29 In figure, if QT $\perp$ PR, $\angle$TQR = 40° and $\angle$SPR = 30°, find x and y.



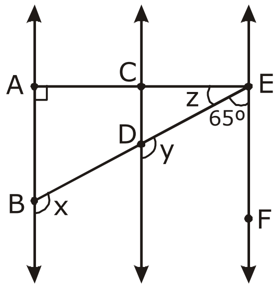
Q.30 In figure lines AB and CD intersect each other at point O. It is given that, a : b = 1 : 3
Find $\angle BOC$, $\angle BOD$ and reflex $\angle POD$.



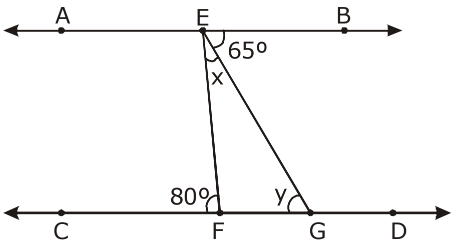
Q.31 In figure, if AB || DE, $\angle ABC = 55^\circ$ and $\angle CDE = 160^\circ$, then find $\angle BCD$.



Q.32 In figure AB || CD and CD || EF. Also EA $\perp$ AB. If $\angle BEF = 65^\circ$, then find the angles x, y and z.

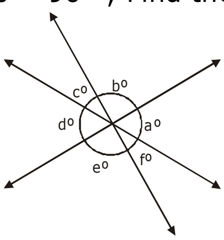


Q.33 In figure if AB || CD, $\angle BEG = 65^\circ$ and $\angle EFC = 80^\circ$, then find x and y.

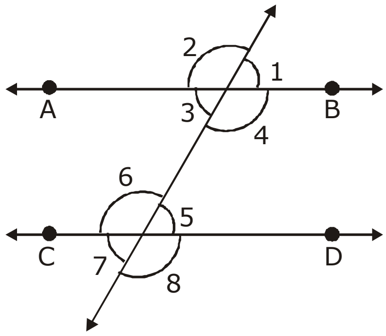


Q.34 Two supplementary angles differ by 34°. Find the angles.

Q.35 In fig, three coplanar lines intersect in a common point, forming angles as shown. Given $a = 50^\circ$ and $b = 90^\circ$; Find the values of c, d, e and f.



Q.36 In fig, given that AB || CD.



(i) If $\angle 1 = (120 - x)^\circ$ and $\angle 5 = 5x^\circ$, find the measures of $\angle 1$ and $\angle 5$.

(ii) If $\angle 4 = (x + 20)^\circ$ and $\angle 5 = (x + 8)^\circ$, find the measure of $\angle 4$ and $\angle 5$.

(iii) If $\angle 2 = (3x - 10)^\circ$ and $\angle 8 = (5x - 30)^\circ$, determine the measures of $\angle 2$ and $\angle 8$.

(iv) If $\angle 1 = (2x + y)^\circ$ and $\angle 6 = (3x - y)^\circ$, determine the measures of $\angle 2$ in terms of y.

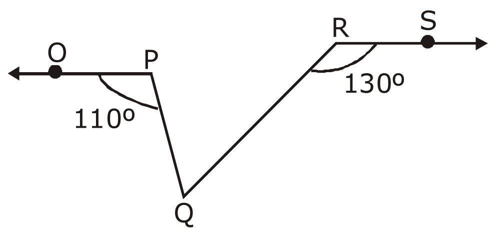
(v) If $\angle 2 = (2x + 30)^\circ$, $\angle 4 = (x + 2y)^\circ$ and $\angle 6 = (3y + 10)^\circ$, find the measure of $\angle 5$.

(vi) If $\angle 2 = 2\ (\angle 1)$, determine $\angle 7$.

(vii) If the ratio of the measures of $\angle 3$ and $\angle 8$ is 4 : 5, find the measure $\angle 3$ and $\angle 8$

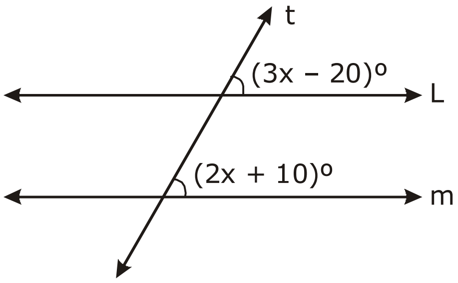
(viii) If the complement of $\angle 5$ equals the supplement of $\angle 4$, find the measures of $\angle 4$ and $\angle 5$.

Q.37 In fig, OP || RS. Determine $\angle PQR$.

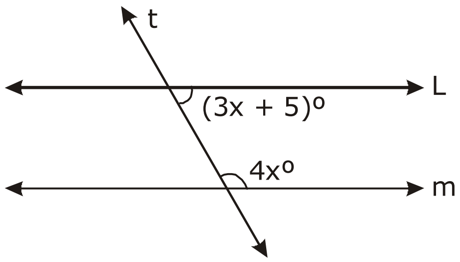


Q.38 For what value of x will the lines l and m be parallel to each other?

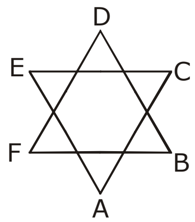
(i)



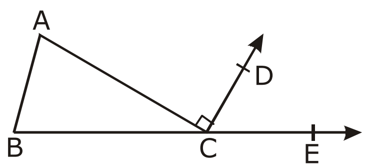
(ii)



Q.39 In the adjoining figure, show that $\angle A + \angle B + \angle C + \angle D + \angle E + \angle F = 360°$.



Q.40 In the given figure, ABC is a triangle in which $\angle A : \angle B : \angle C = 3 : 2 : 1$ and $AC \perp CD$. Find the measure of $\angle ECD$.



ANSWER KEY

1. 72°, 108° **2.** 59°40′

3. 45°29′34″ **4.** 93° **5.** 140°

6. 325° **7.** x = 20, $\angle$BAD = 50° $\angle$CAD = 130°

8. 305° **9.** (i)68° (ii)27°

10. 36° **11.** (i)135° (ii)123° **12.** 54°, 126°.

13. x = 15°.

14. $\angle b = 145°$, $\angle c = 35°$, $\angle d = 145°$

15. a = 84°, b = 21° and c = 48°.

16. $\angle AOC = 140°$ and $\angle BOC = 40°$.

18. $\angle BOE = 30°$ and reflex $\angle COE = 250°$.

19. a = 80°, b = 100°, c = 80° and d = 100°

20. c = 126° **24.** $\angle A = 25°$

25. 40°, 60° and 80°. **27.** 80° and 65°.

28. x = 80°, y = 40°. **29.** x = 50°, y = 80°.

30. $\angle BOC = 130°$; $\angle BOD = 50°$; Reflex $\angle POD = 200°$

31. $\angle BCD = 35°$

32. x = 115°; y = 115°; z = 25°

33. x = 15°; y = 65°

34. 73°; 107°

35. c = 40, d = 50, e = 90 and f = 40.

36. (i) $\angle 1 = 100°$; $\angle 5 = 100°$

(ii) $\angle 4 = 96°$; $\angle 5 = 84°$

(iii) $\angle 2 = 20°$; $\angle 8 = 20°$

(iv) $\angle 2 = (108 - y)°$

(v) $\angle 5 = 50°$ (vi) $\angle 7 = 60°$

(vii) $\angle 3 = 80°$; $\angle 8 = 100°$

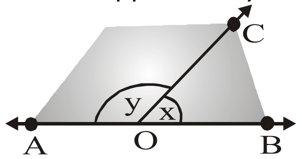
(viii) $\angle 5 = 45°$; $\angle 4 = 135°$

37. $\angle PQR = 60°$ **38.** (i) 30°, (ii) 25°

40. 60

EXERCISE – II   SCHOOL EXAM/BOARD

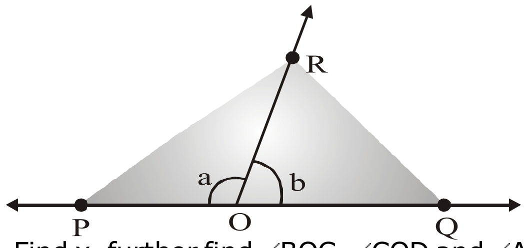
Q.1 OA and OB are opposite rays.



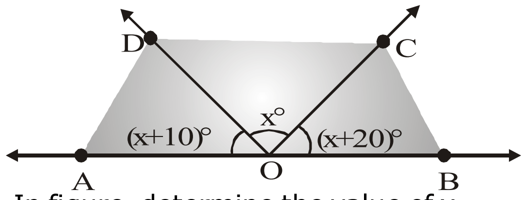
(i) If x = 75°, what is the value of y?

(ii) If y = 110°, what is the value of x?

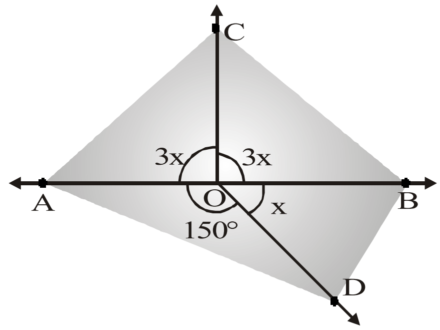
Q.2 ∠POR and ∠QOR form a linear pair. If a – b = 80, find the values of a and b.



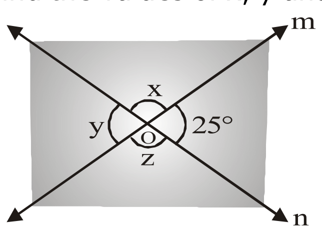
Q.3 Find x, further find ∠BOC, ∠COD and ∠AOD



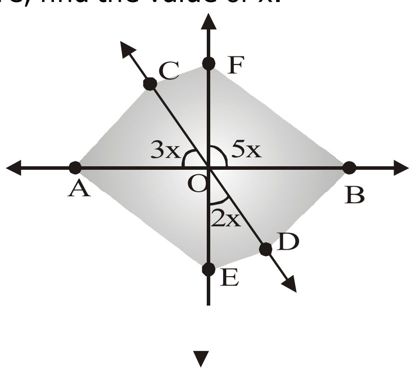
Q.4 In figure, determine the value of x.



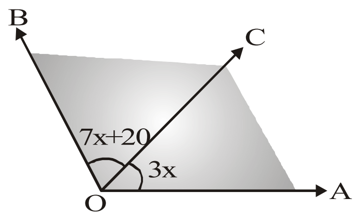
Q.5 In figure, find the values of x, y and z.



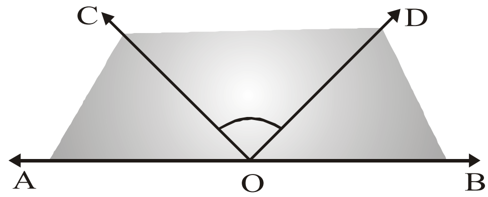
Q.6 In figure, find the value of x.



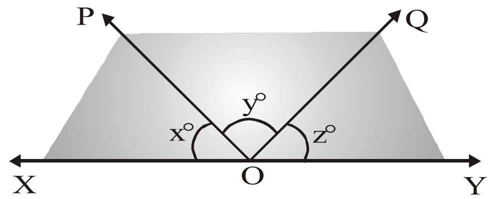
Q.7 In figure, if ∠BOC = 7x + 20° and ∠COA = 3x, then find the value of x for which AOB becomes a straight line.



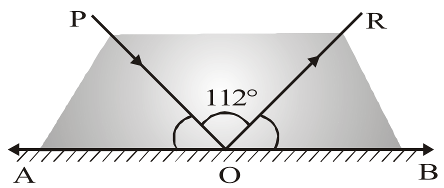
Q.8 In figure, find ∠COD when ∠AOC + ∠BOD = 100°.



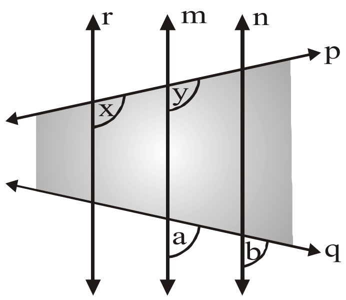
Q.9 In figure, x : y : z = 5 : 4 : 6. If XOY is a straight line find the values of x, y and z.



Q.10 In the given figure, AB is a mirror, PO is the incident ray and OR, the reflected ray. If ∠POR = 112° find ∠POA.



Q.11 In figure if x = y and a = b, prove that r||n.

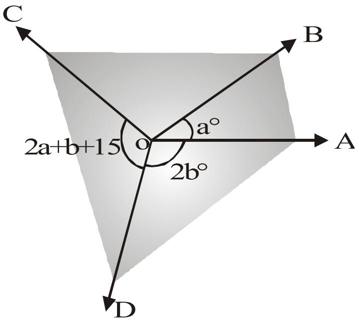


Q.12 If p, m, n are three lines such that p||m and n⊥p, prove that n⊥m.

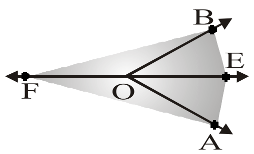
Q.13 A transversal intersects two given lines in such a way that the interior angles on the same side of the transversal are equal. Is it always true that the given lines are parallel? If not, state the condition(s) under which the two lines will be parallel.

Q.14 If the angles of a triangle are in the ratio 2 : 3 : 4, find the three angles.

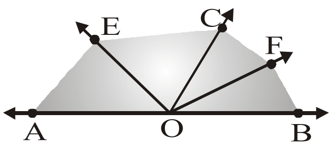
Q.15 In the given figure, 2b – a = 65° and ∠BOC = 90°, find the measure of ∠AOB, ∠AOD and ∠COD.



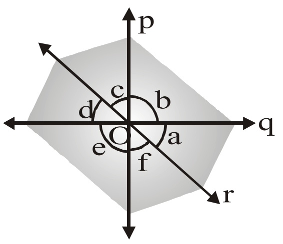
Q.16 In figure, ray OE bisects ∠AOB and OF is a ray opposite to OE. Show that ∠FOB = ∠FOA.



Q.17 In figure, ray OE bisects ∠AOC and OF bisects ∠COB and OE⊥OF. Show that A, O, B are collinear.



Q.18 In figure, three lines p, q and r are concurrent at O. If a = 50° and b = 90°, find c, d, e and f.



Q.19 AB, CD and EF are three concurrent lines passing through the point O such that OF bisects ∠BOD. If ∠BOF = 35°, find ∠BOC and ∠AOD.

Q.20 Prove that the bisectors of a pair of vertically opposite angles are in the same straight line.

OR

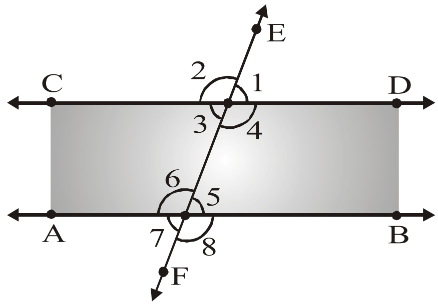
AB and CD are two intersecting lines. OP and OQ are respectively bisectors of ∠BOD and∠AOC. Show that OP and OQ are opposite rays.

Q.21 One of the four angles formed by two intersecting lines is a right angle. Show that the other three angles will also be right angles.

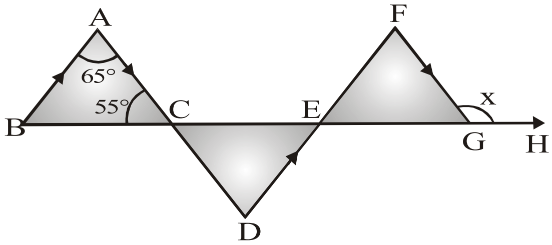
Q.22 In figure, given that AB||CD.

(i) If ∠1 = (120 – x)° and ∠5 = 5x°, find the measures of ∠1 and ∠5.

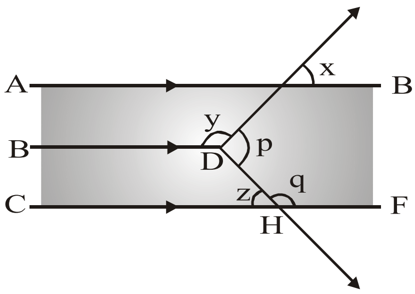
(ii) If ∠2 = (3x – 10)° and ∠8 = (5x – 30)°, find the measures of ∠2 and ∠8.



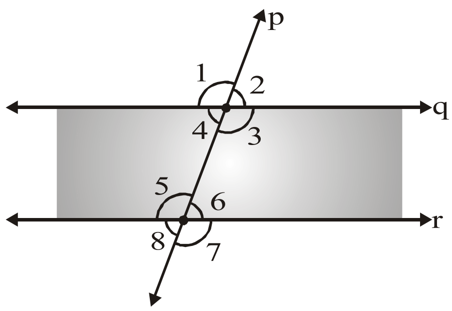
Q.23 In figure if BA||DF, AD||FG, ∠BAC = 65° and ∠ACB = 55°, then find ∠FGH.



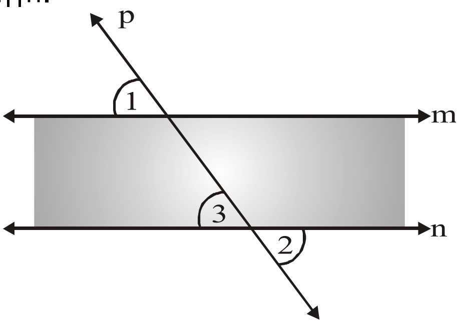
Q.24 In figure, AB, CD and EF are three parallel lines, if 4y = 5x and z = y – 30, find ∠q.



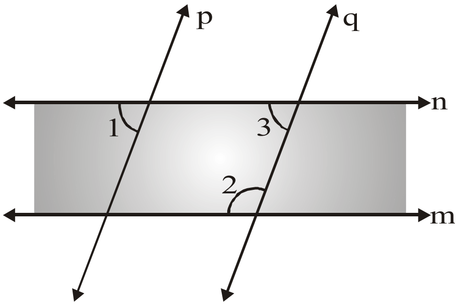
Q.25 In figure, if p is a transversal to lines q and r, q¯r and ∠ 1 and ∠ 2 are in the ratio 3 : 2, find all the angles.



Q.26 In figure p is a transversal to lines m and n, $\angle 1 = 60°$ and $\angle 2 = \frac{2}{3}$ of a right angle. Prove that m||n.

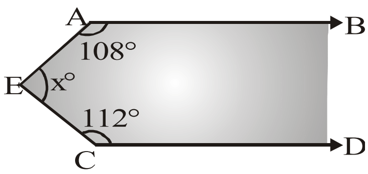


Q.27 In figure, n||m and p||q. If $\angle 1 = 75°$, prove that $\angle 2 = \angle 1 + \frac{1}{3}$ of a right angle.

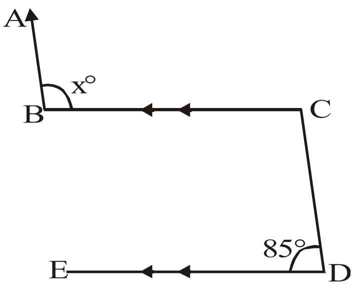


Q.28 Find the value of x, if.

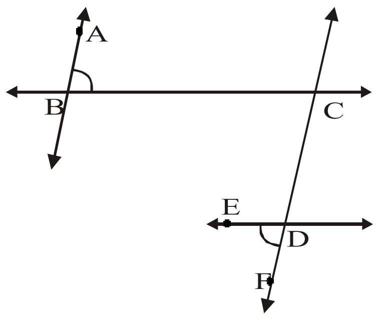
(i) In figure, AB¯CD



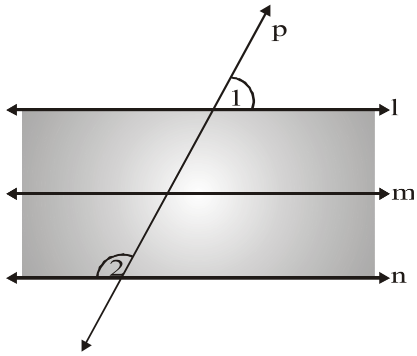
(ii) In figure, AB||CD and BC||DE



Q.29 In figure, AB||CF and BC||ED. Prove that $\angle ABC = \angle FDE$.



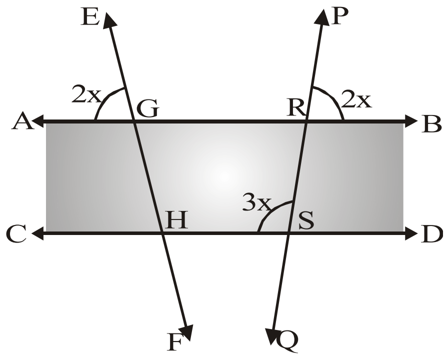
Q.30 In figure if l, m and n are parallel lines, p is a transversal and $\angle 1 = 60°$, then find $\angle 2$.



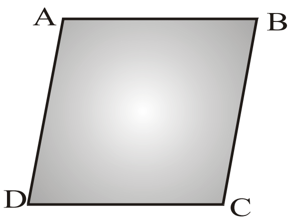
Q.31 In figure, if AB||CD then find the value of

(i) x **(ii)** $\angle GHS$ **(iii)** $\angle PRG$

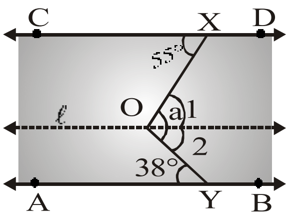
(iv) $\angle CHF$ **(v)** $\angle RSD$



Q.32 If figure, AB||DC and AD||BC. Prove that $\angle DAB = \angle DCB$.



Q.33 If figure, AB||CD. Determine $\angle a$.



Q.34 One of the angles of a triangle is 65°. Find the remaining two angles, if their difference is 25°.

Q.35 Prove that if one angle of a triangle is equal to the sum of the other two angles, the triangle is right angled.

Q.36 Side BC of a ΔABC is produced in both the directions. Prove that the sum of the two exterior angles so formed is greater than 180°.

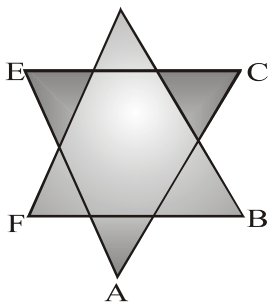
Q.37 The side EF, FD and DE of a triangle DEF are produced in order forming three exterior angles DFP, EDQ and FER respectively. Prove that $\angle DFP + \angle EDQ + \angle FER = 360°$.

Q.38 In ΔABC, $\angle B = 45°$, $\angle C = 55°$ and bisector of $\angle A$ meets BC at a point D. Find $\angle ADB$ and $\angle ADC$.

Q.39 Prove that if two parallel lines are intersected by a transversal, then the bisectors of the interior angles on the same side of the transversal intersect at right angles.

Q.40 If two angles of a triangle are equal and complementary, what kind of triangle is it?

Q.41 In fig, show that $\angle A + \angle B + \angle C + \angle D + \angle E + \angle F = 360°$.



Q.42 The side BC of a triangle ABC is produced to ray BC such that D is on ray BC. The bisector of $\angle A$ meets BC in L. Prove that $\angle ABC + \angle ACD = 2\angle ALC$.

Q.43 Two angles of a triangle are equal and the third angle is greater than each of these angles by 30°. Find all the angles of the triangle.

Q.44 The side BC of a triangle ABC has been produced both ways to D and E. If $\angle ABD = 125°$ and $\angle ACE = 130°$, then find $\angle BAC$.

Q.45 **Which Of The Following Statements Are True (T) And Which Are False (F) :**

(a) Angles forming a linear pair are supplementary.

(b) If two adjacent angles are equal, then each angle measures 90°

(c) Angles forming a linear pair can both be acute angles.

(d) If angles forming a linear pair are equal, then each of these angles is of measure 90°

(e) If two lines are intersected by a transversal, then corresponding angles are equal.

(f) If two parallel lines are intersected by a transversal, then alternate interior angles are equal.

(g) Two lines perpendicular to the same line are perpendicular to each other.

(h) Two lines parallel to the same line are parallel to each other.

(i) If two parallel lines are intersected by a transversal, then the interior angles on the same side of the transversal are equal.

(j) Sum of the three angles of a triangle is 180°

(k) An exterior angle of a triangle is less than either of its interior opposite angles.

(l) An exterior angle of a triangle is equal to the sum of the two interior opposite angles.

(m) An exterior angle of a triangle is greater than the opposite interior angles.

(n) Two distinct lines in a plane can have two points in common.

(o) If two lines intersect and if one pair of vertically opposite angles is formed by acute angles, then the other pair of vertically opposite angles will be formed by obtuse angles.

(p) If two lines intersect and one of the angles so formed is a right angle, then the other three angles will not be right angles.

(q) Two lines that are respectively perpendicular to two intersecting lines always intersect each other.

(r) The two lines that are respectively perpendicular to two parallel lines are parallel to each other.

(s) Through a given point, we can draw only one perpendicular to a given line.

(t) Two lines that are respectively parallel to two intersecting lines, intersect each other.

Q.46 **Fill In The Blanks :**

(a) If one angle of a linear pair is acute, then its other angle will be________.

(b) A ray stands on a line, then the sum of the two adjacent angles so formed is________.

(c) If the sum of two adjacent angles is 180°, then the________ arms of the two angles are opposite rays.

(d) If two parallel lines are intersected by a transversal, then each pair of corresponding angles are________.

(e) If two parallel lines are intersected by a transversal, then interior angles on the same side of the transversal are ________.

(f) Two lines perpendicular to the same line are________to each other.

(g) Two lines parallel to the same line are________two each other.

(h) If a transversal intersects a pair of lines in such a way that a pair of alternate angles are equal, then the lines are________.

(i) If a transversal intersects a pair of lines in such a way that the sum of interior angles on the same side of transversal is 180°, then the lines are________.

(j) Sum of the angles of a triangle is________.

(k) An exterior angle of a triangle is equal to the sum of two________opposite angles.

(l) An exterior angle of a triangle is always________than either of the interior opposite angles.

(m) Two distinct points in a plane determine a________line.

(n) Two distinct_____in a plane cannot have more than one point in common.

(o) Given a line and a point, not on the line, there is one and only______line which passes through the given point and is ______to the given line.

(p) A line separates a plane into_______parts namely the two_____and the______itself.

(q) Two angles which have their arms parallel are either______or______.

(r) Two angles whose arms are perpendicular are either______or______.

(s) A triangle cannot have more than_______right angle(s).

(t) A triangle cannot have more than______obtuse angle(s).

ANSWER KEY

1. **(i)** $y = 105°$, **(ii)** $x = 70°$

2. $a = 130°$ and $b = 50°$

3. $x = 50°$, $\angle BOC = 70°$, $\angle COD = 50°$, $\angle AOD = 60°$

4. $x = 30°$

5. $x = 155°$, $y = 25°$, $z = 155°$ **6.** $x = 18°$

7. $x = 16°$ **8.** $\angle COD = 80°$

9. $x = 60°$, $y = 48°$, $z = 72°$

10. $\angle POA = 34°$ **13.** No

14. 40°, 60°, 80°

15. $\angle AOB = 35°$, $\angle AOD = 100°$, $\angle COD = 135°$

18. $c = 40°$, $d = 50°$, $e = 90°$, $f = 40°$

19. $\angle BOC = 110°$, $\angle AOD = 110°$

22. **(i)** $\angle 1 = 100°$, $\angle 5 = 100°$, **(ii)** $\angle 2 = 20°$, $\angle 8 = 20°$

23. $\angle FGH = 125°$ **24.** $\angle q = 110°$

25. $\angle 1 = 108°$, $\angle 2 = 72°$, $\angle 3 = 108°$, $\angle 4 = 72°$, $\angle 5 = 108°$, $\angle 6 = 72°$, $\angle 7 = 108°$, $\angle 8 = 72°$

28. **(i)** $x = 140$, **(ii)** $x = 95$

30. 120°

31. **(i)** 36°, **(ii)** 108°, **(iii)** 108°, **(iv)** 108°, **(v)** 72°

33. 93° **34.** 70°, 45°

38. $\angle ADB = 95°$, $\angle ADC = 85°$

40. Isosceles right angled triangle.

43. 50°, 50°, 80° **44.** 75°

45. ***True & False :***

(a) T **(b)** F **(c)** F **(d)** T **(e)** F
(f) T **(g)** F **(h)** T **(i)** F **(j)** T
(k) F **(l)** T **(m)** T **(n)** F **(o)** T
(p) F **(q)** T **(r)** T **(s)** T **(t)** T

46. ***Fill In The Blanks :***

(a) Obtuse **(b)** 180°

(c) Uncommon **(d)** Equal

(e) Supplementary

(f) Parallel **(g)** Parallel **(h)** Parallel

(i) Parallel **(j)** 180°

(k) Interior **(l)** Greater **(m)** Unique

(n) Lines

(o) One, Parallel (or Perpendicular)

(p) Three, Half planes, line

(q) Equal, Supplementary

(r) Equal, Supplementary **(s)** One

(t) One

EXERCISE – III MULTIPLE CHOICE QUESTIONS

Q.1 If two angles are complements of each other, then each angle is
(A) an acute angle (B) an obtuse angle
(C) a right angle (D) a reflex angle

Q.2 A angle which measures more than 180^o but less than 360^o, is called
(A) an acute angle (B) an obtuse angle
(C) a straight angle (D) a reflex angle

Q.3 The complement of $72^o40^o{'}$ is
(A) $107^o20'$ (B) $27^o20'$
(C) $17^o20'$ (D) $12^o40'$

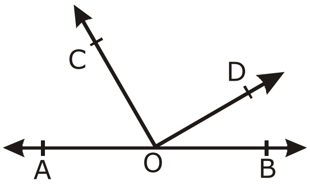
Q.4 The supplement of $54^o30'$ is
(A) $35^o30'$ (B) $125^o30'$
(C) $45^o30'$ (D) $65^o30'$

Q.5 The measure of an angle is five times its complement. The angle measures
(A) 25^o (B) 35^o (C) 65^o (D) 75^o

Q.6 Two complementary angles are such that twice the measure of the one is equal to three times the measure of the other. The larger of the two measures
(A) 72^o (B) 54^o (C) 63^o (D) 36^o

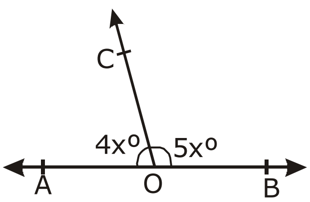
Q.7 Two straight line AB and CD cut each other at O. If $\angle BOD = 63^o$, $\angle BOC = ?$
(A) 63^o (B) 117^o (C) 17^o (D) 153^o

Q.8 In the given figure AOB is a straight line. If $\angle AOC + \angle BOD = 95^o$, then $\angle COD = ?$



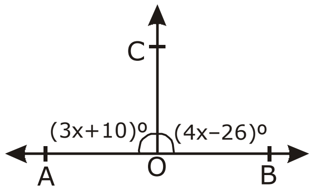
(A) 95^o (B) 85^o (C) 90^o (D) 55^o

Q.9 In the given figure, AOB is a straight line. If $\angle AOC = 4x^o$ and $\angle BOC = 5x^o$, then $\angle AOC = ?$



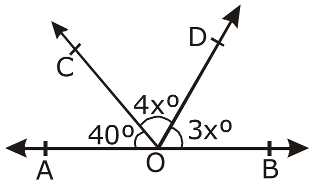
(A) 40^o (B) 60^o (C) 80^o (D) 100^o

Q.10 In the figure, AOB is a straight line. If $\angle AOC = (3x+10)^o$ and $\angle BOC = (4x-26)^o$, then $\angle BOC = ?$



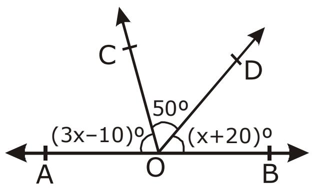
(A) 96^o (B) 86^o (C) 76^o (D) 106^o

Q.11 In the given figure, AOB is a straight line. If $\angle AOC = 40^o$, $\angle COD = 4x^o$ and $\angle BOD = 3x^o$, then $\angle COD = ?$



(A) 80^o (B) 100^o (C) 120^o (D) 140^o

Q.12 In the given figure, AOB is a straight line. If $\angle AOC = (3x - 10)^o$, $\angle COD = 50^o$ and $\angle BOD = (x + 20)^o$, then $\angle AOC = ?$

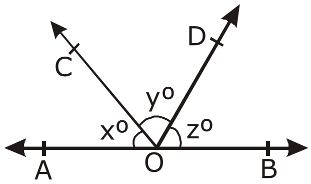


(A) 40^o (B) 60^o (C) 80^o (D) 50^o

Q.13 Which of the following statements is false?
(A) Through a give point, only one straight line can be drawn
(B) Through two given points, it is possible to draw one and only one straight line.
(C) Two straight lines can intersect only at one point.
(D) A line segment can be produced to any desired length.

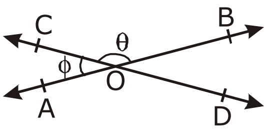
Q.14 An angle is one-fifth of its supplement. The measure of the angle is
(A) 15^o (B) 30^o (C) 75^o (D) 150^o

Q.15 In the adjoining figure, AOB is a straight line. If $x : y : z = 4 : 5 : 6$, then y = ?



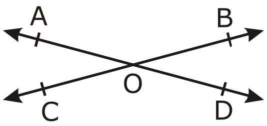
(A) 60° (B) 80° (C) 48° (D) 72°

Q.16 In the given figure, straight lines AB and CD intersect at O. If $\angle AOC = \phi$, $\angle BOC = \theta$ and $\theta = 3\phi$, then ϕ = ?



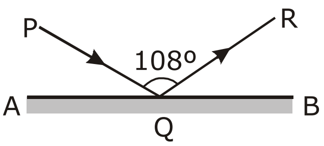
(A) 30° (B) 40° (C) 45° (D) 60°

Q.17 In the given figure, straight line AB and CD intersect at O. If $\angle AOC + \angle BOD = 130^\circ$, then $\angle AOD$ = ?



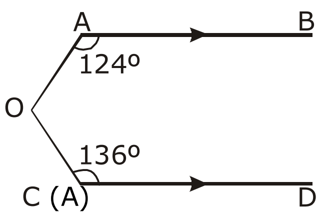
(A) 65° (B) 115° (C) 110° (D) 125°

Q.18 In the given figure AB is a mirror, PQ is the incident ray and QR is the reflected ray. If $\angle PQR = 108^\circ$, then $\angle AQP$ = ?



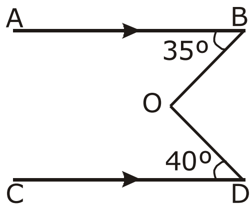
(A) 72° (B) 18° (C) 36° (D) 54°

Q.19 In the given figure AB || CD. If $\angle OAB = 124^\circ$, $\angle OCD = 136^\circ$, then $\angle AOC$ = ?



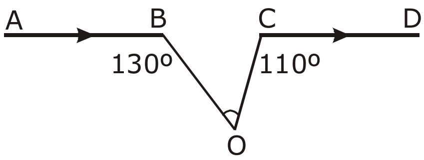
80° (B) 90° (C) 100° (D) 110°

Q.20 In the given figure AB || CD and O is a point joined with B and D, as shown in the figure such that $\angle ABO = 35^\circ$ and $\angle CDO = 40^\circ$. Reflex $\angle BOD$=?



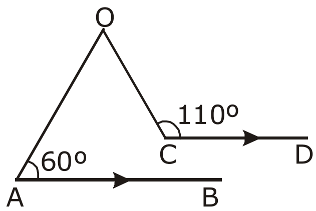
(A) 255° (B) 265° (C) 275° (D) 285°

Q.21 In the given, AB || CD. If $\angle ABO = 130^\circ$ and $\angle OCD = 110^\circ$, then $\angle BOC$ = ?



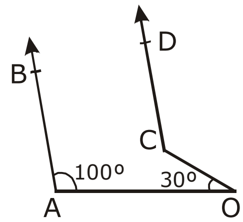
(A) 50° (B) 60° (C) 70° (D) 80°

Q.22 In the given figure, AB || CD. If $\angle BAO = 60^\circ$ and $\angle OCD = 110^\circ$, then $\angle AOC$ = ?



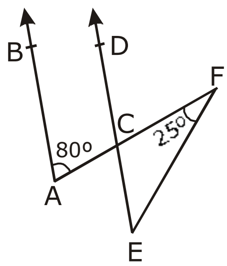
(A) 70° (B) 60° (C) 50° (D) 40°

Q.23 In the given figure AB || CD. If $\angle AOC = 30^\circ$ and $\angle OAB = 100^\circ$, then $\angle OCD$ = ?



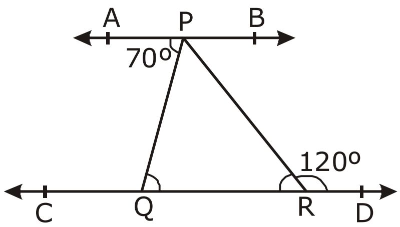
(A) 130° (B) 150° (C) 80° (D) 100°

Q.24 In the given figure, AB || CD. If $\angle CAB = 80^\circ$ and $\angle EFC = 25^\circ$, then $\angle CEF$ = ?



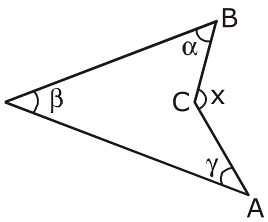
(A) 65° (B) 55° (C) 45° (D) 75°

Q.25 In the given figure, AB || CD. If $\angle APQ = 70^o$ and $\angle PRD = 120^o$, then $\angle QPR$ = ?



(A) 50^o (B) 60^o (C) 40^o (D) 35^o

Q.26 In the given figure, x = ?



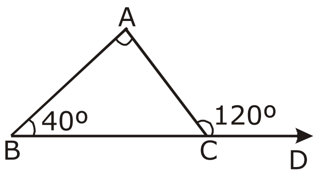
(A) $\alpha + \beta - \gamma$ (B) $\alpha - \beta + \gamma$
(C) $\alpha + \beta + \gamma$ (D) $\alpha + \gamma - \beta$

Q.27 If $3\angle A = 4\angle B = 6\angle C$, then A : B : C = ?
(A) 3 : 4 : 6 (B) 4 : 3 : 2
(C) 2 : 3 : 4 (D) 6 : 4 : 3

Q.28 In ΔABC, if $\angle A + \angle B = 125^o$ and $\angle A + \angle C = 113^o$, then $\angle A$ = ?
(A) $(62.5)^o$ (B) $(56.5)^o$
(C) 58^o (D) 63^o

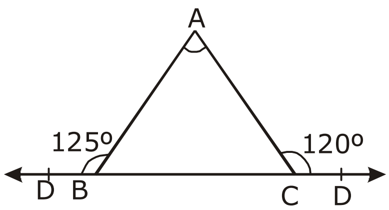
Q.29 In ΔABC, if $\angle A - \angle B = 42^o$ and $\angle B - \angle C = 21^o$, then $\angle B$ = ?
(A) 95^o (B) 53^o (C) 32^o (D) 63^o

Q.30 In ΔABC, side BC is produced to D. If $\angle ABC = 40^o$ and $\angle ACD = 120^o$, then $\angle A$ = ?



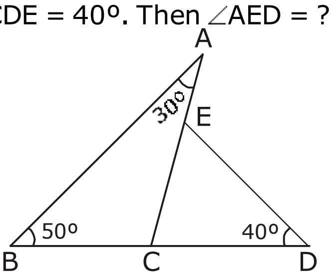
(A) 60^o (B) 40^o (C) 80^o (D) 50^o

Q.31 Side BC to ΔABC has been produced to D on left hand side and to E on right hand side such that $\angle ABD = 125^o$ and $\angle ACE = 130^o$. Then $\angle A$ = ?



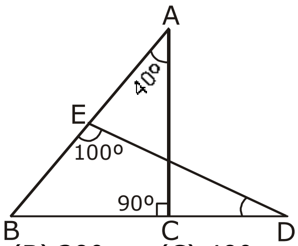
(A) 65^o (B) 75^o (C) 50^o (D) 55^o

Q.32 In the given figure, $\angle BAC = 30^o$, $\angle ABC = 50^o$ and $\angle CDE = 40^o$. Then $\angle AED$ = ?



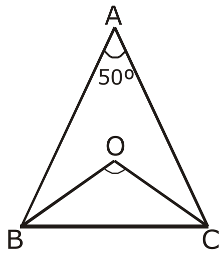
(A) 120^o (B) 100^o (C) 80^o (D) 110^o

Q.33 In the given figure, $\angle BAC = 40^o$, $\angle ACB = 90^o$ and $\angle BED = 100^o$. Then $\angle BDE$ = ?



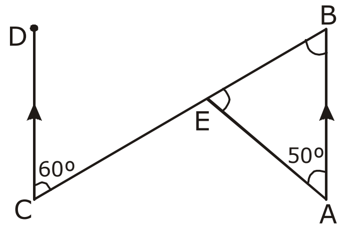
(A) 50^o (B) 30^o (C) 40^o (D) 25^o

Q.34 In the given figure, BO and CO are the bisectors of $\angle B$ and $\angle C$ respectively. If $\angle A = 50^o$, then $\angle BOC$ = ?



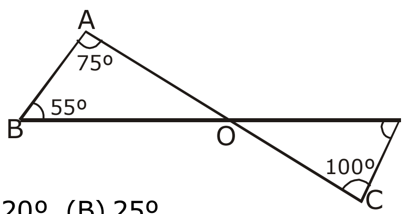
(A) 130^o (B) 100^o (C) 115^o (D) 120^o

Q.35 In the given figure, AB || CD. If $\angle EAB = 50^o$ and $\angle ECD = 60^o$, then $\angle AEB$ = ?



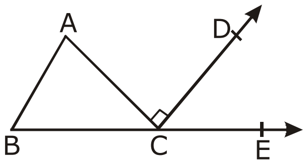
(A) 50^o (B) 60^o (C) 70^o (D) 55^o

Q.36 In the given figure, $\angle OAB = 75^o$, $\angle OBA = 55^o$ and $\angle OCD = 100^o$. Then $\angle ODC$ = ?



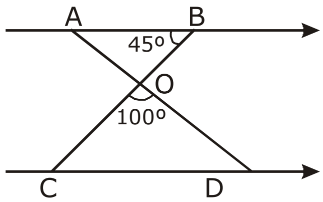
(A) 20^o (B) 25^o (C) 30^o (D) 35^o

Q.37 In a ΔABC it is given that $\angle A : \angle B : \angle C = 3 : 2 : 1$ and $CD \perp AC$. Then $\angle ECD$ = ?



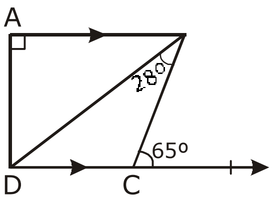
(A) 60° (B) 45° (C) 75° (D) 30°

Q.38 In the given figure AB || CD. If $\angle ABO = 45^\circ$ and $\angle COD = 100^\circ$ then $\angle CDO$ = ?



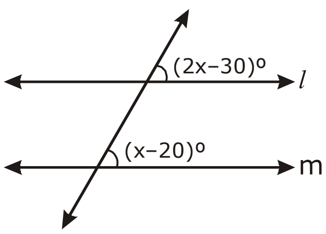
(A) 25° (B) 30° (C) 35° (D) 45°

Q.39 In the given figure, AB || DE, $\angle BAD = 90^\circ$, $\angle CBD = 28^\circ$ and $\angle BCE = 65^\circ$. Then $\angle ABD$ = ?



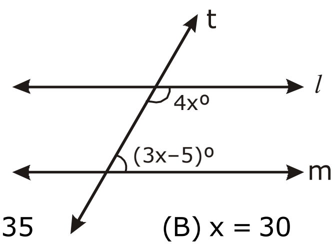
(A) 32° (B) 37° (C) 43° (D) 53°

Q.40 For what value of x shall we have $l \parallel m$?



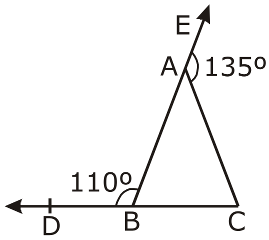
(A) x = 50 (B) x = 70
(C) x = 60 (D) x = 45

Q.41 For what value of x shall be we have $l \parallel m$?



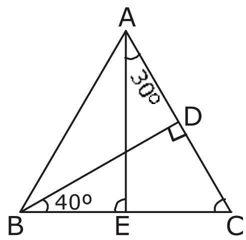
(A) x = 35 (B) x = 30
(C) x = 25 (D) x = 20

Q.42 In the given figure, sides CB and BA of ΔABC have been produced to D and E respectively such that $\angle ABD = 110^\circ$ and $\angle CAE = 135^\circ$. Then $\angle ACB$ = ?



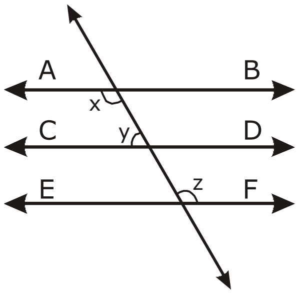
(A) 35° (B) 45° (C) 55° (D) 65°

Q.43 In ΔABC, $BD \perp AC$, $\angle CAE = 30^\circ$ and $\angle CBD = 40^\circ$. Then $\angle AEB$ = ?



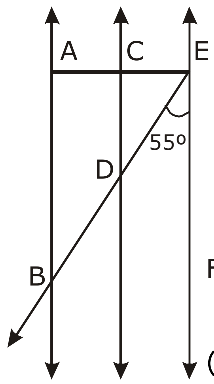
(A) 70° (B) 80° (C) 50° (D) 60°

Q.44 In the given figure, AB || CD, CD || EF and y : z = 3 : 7, then x = ?



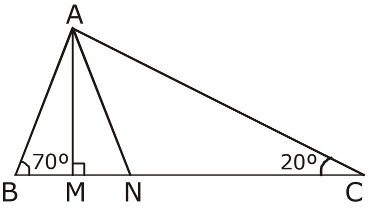
(A) 108° (B) 126° (C) 162° (D) 63°

Q.45 In the given figure, AB || CD || EF, $EA \perp AB$ and BDE is the transversal such that $\angle DEF = 55^\circ$. Then $\angle AEB$ = ?



(A) 35° (B) 45° (C) 25° (D) 55°

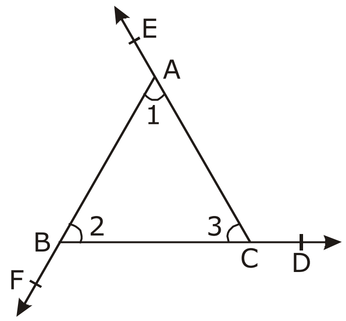
Q.46 In the given figure, $AM \perp BC$ and AN is the bisector of $\angle A$. If $\angle ABC = 70^\circ$ and $\angle ACB = 20^\circ$, then $\angle MAN = ?$



(A) 20° (B) 25° (C) 15° (D) 30°

Q.47 An exterior angle of a triangle is 110° and one of its interior opposite angles is 45°, then the other interior opposite angle is
(A) 45° (B) 65° (C) 25° (D) 135°

Q.48 The sides BC, CA and AB of ΔABC have been produced to D, E and F respectively as shown in the figure, forming exterior angles $\angle ACD$, $\angle BAE$ and $\angle CBF$. Then, $\angle ACD + \angle BAE + \angle CBF = ?$

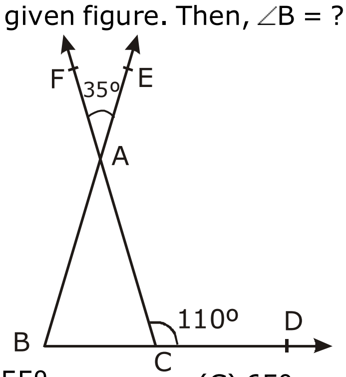


(A) 240° (B) 300° (C) 320° (D) 360°

Q.49 The angles of a triangle are in the ratio 3 : 5 : 7. The triangle is
(A) acute angled (B) right-angled
(C) obtuse angled (D) isosceles

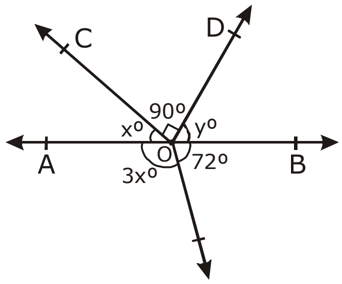
Q.50 If the vertical angle of a triangle is 130°,then the angle between the bisectors of the base angles of the triangle is
(A) 65° (B) 100° (C) 130° (D) 155°

Q.51 The sides BC, BA and CA of ΔABC have been produced to D, E and F respectively, as shown in the given figure. Then, $\angle B = ?$



(A) 35° (B) 55° (C) 65° (D) 75°

Q.52 In the adjoining figure, y = ?



(A) 36° (B) 54° (C) 63° (D) 72°

Q.53 If B lies between A and C, AC = 15 cm and BC = 9 cm then AB^2 is
(A) 306 (B) 144 (C) 36 (D) 24

Q.54 The difference of two complimentary angles is 40°. Then the angles are
(A) $65^\circ, 25^\circ$ (B) $70^\circ, 20^\circ$
(C) $70^\circ, 30^\circ$ (D) $60^\circ, 30^\circ$

Q.55 The measure of an angle is four times the measure of its supplementary angle. Then the angles are
(A) $36^\circ, 144^\circ$ (B) $40^\circ, 160^\circ$
(C) $18^\circ, 72^\circ$ (D) $50^\circ, 200^\circ$

Q.56 Which of the following pair is a complementary?
(A) $37^\circ, 43^\circ$ (B) $28^\circ, 52^\circ$
(C) $55^\circ, 35^\circ$ (D) $34^\circ, 66^\circ$

Q.57 If two supplementary angles are in the ratio 4 : 5 then the angles are
(A) $80^\circ, 100^\circ$ (B) $85^\circ, 95^\circ$
(C) $40^\circ, 50^\circ$ (D) $60^\circ, 120^\circ$

Q.58 Complement of 25° is
(A) 75° (B) 65° (C) 85° (D) 55°

Q.59 The supplement of an angle is one third of itself. Then the angle of its supplement are
(A) $135^\circ, 45^\circ$ (B) $60^\circ, 180^\circ$
(C) $120^\circ, 360^\circ$ (D) $60^\circ, 120^\circ$

Q.60 The difference of two complementary angles is 40°. Then the angles are
(A) $50^\circ, 40^\circ$ (B) $65^\circ, 25^\circ$
(C) $70^\circ, 30^\circ$ (D) $40^\circ, 50^\circ$

Q.61 The sum of the two angles in a triangle is 95° and their difference is 25°. Then the angles of a triangle is
(A) $75^\circ, 50^\circ, 55^\circ$ (B) $85^\circ, 65^\circ, 30^\circ$
(C) $50^\circ, 45^\circ, 85^\circ$ (D) $60^\circ, 35^\circ, 85^\circ$

Q.62 The value of internal and the external bisectors of an angle is
(A) 90^o (B) 180^o (C) 270^o (D) none

Q.63 In a right angled triangle, the square of the hypotenuse is equal to twice the product of the other two sides. One of the acute angles of the triangle is
(A) 60^o (B) 45^o (C) 30^o (D) 75^o

Q.64 If D is a mid point of the hypotenuse AC of a right triangle ABC then BD is equal to
(A) $\frac{1}{2}$AC (B) AC
(C) $\frac{3}{2}$AC (D) 2AC

Q.65 In ΔABC if $\angle B = \angle C = 45^o$, which of the following is the longest side?
(A) AB (B) AC (C) BC (D) None

Q.66 In a ΔABC if $\angle A = 45^o$ and $\angle B = 70^o$ then the shortest and the largest sides of the triangle are
(A) AB, BC (B) BC, AC
(C) AB, AC (D) none

Q.67 In a ΔABC if $2\angle A = 3\angle B = 6\angle C$ then $\angle A$, $\angle B$, $\angle C$ are
(A) $30^o, 60^o, 90^o$ (B) $90^o, 60^o, 30^o$
(C) $30^o, 90^o, 60^o$ (D) none of these

Q.68 A, B, C are the three angles of a triangle. If $A - B = 15^o$, $B - C = 30^o$ then $\angle A$, $\angle B$, $\angle C$ are
(A) $80^o, 65^o, 35^o$ (B) $65^o, 80^o, 35^o$
(C) $35^o, 80^o, 65^o$ (D) $80^o, 35^o, 65^o$

Q.69 Complementary angle of $72½^o$ is
(A) 17^o, (B) $18½^o$ (C) $21½^o$ (D) $17½^o$

Q.70 Supplementary angle of 108.5^o is
(A) 70.5^o (B) 71.5^o
(C) 71^o (D) 72.5^o

Q.71 An angle which measures 90^o is called
(A) straight (B) acute
(C) right (D) left

Q.72 Measure of an obtuse angle is
(A) $> 0^o, < 90^o$ (B) $> 90^o, < 180^o$
(C) $> 0^o, < 270^o$ (D) $> 0^o, < 180^o$

Q.73 An angle which is more than 180^o and less than 360^o is called
(A) obtuse angle (B) right angle
(C) reflex angle (D) complete angle

Q.74 An angle which is equal to 360^o is called
(A) right angle (B) complete angle
(C) acute angle (D) obtuse angle

Q.75 When two lines meet at a point forming right angles they are said to be ______ to each other.
(A) parallel (B) perpendicular
(C) adjacent (D) none

Q.76 If 6 o'clock the angle formed between the hands of a clock is
(A) straight angle (B) right angle
(C) acute angle (D) obtuse angle

Q.77 Type of angle between the hands of a clock when the time is 5:20 is
(A) right angle (B) straight angle
(C) obtuse angle (D) acute angle

Q.78 At 3 o'clock the angle formed between the hands of a clock is
(A) reflex angle (B) right angle
(C) straight angle (D) acute angle

Q.79 At 9 o'clock, the angle formed between the hands of a clock is
(A) complete angle (B) reflex angle
(C) zero angle (D) none

Q.80 An angle which measures 180^o is called a
(A) straight angle (B) obtuse angle
(C) right angle (D) complete angle

Q.81 Two adjacent angles whose sum is 180^o is called
(A) complementary angles
(B) linear pair
(C) vertically opposite angles
(D) none

Q.82 If one of the linear pair is acute then the measure of the other angle is
(A) right (B) obtuse (C) acute (D) none

Q.83 All linear pairs are
(A) supplementary (B) vertically opposite
(C) right angles (D) none

Q.84 Supplementary and complementary angles need not be
(A) equal to 180º, 90º (B) adjacent
(C) angles (D) none

Q.85 The two rays of an angle are called
(A) lines of the angle
(B) two sides of the angle
(C) two parts of the angle
(D) none

Q.86 The common end point of an angle is called
(A) vertex (B) zero
(C) end point (D) none

Q.87 A rotating ray after making a complete rotation coincides with its initial position. The angle formed is
(A) right angle (B) straight angle
(C) reflex angle (D) complete angle

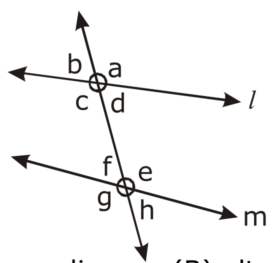
Q.88 The maximum number of letters that can be used to represent an angle are
(A) 5 (B) 2 (C) 3 (D) 1

Q.89 Line l is parallel to line m. Symbolically, above statement is written as
(A) $l \perp m$ (B) $l \parallel m$
(C) $l = m$ (D) none

Q.90 If two lines are parallel then the perpendicular distance between them remains
(A) decreasing (B) increasing
(C) constant (D) none

Q.91 A line which intersects two or more lines at different points is
(A) perpendicular (B) transversal
(C) parallel (D) none

Q.92 In the above figure ∠c and ∠e are called



(A) corresponding (B) alternate
(C) vertically opposite (D) none

Q.93 In the above figure ∠a and ∠e are called
(A) corresponding (B) vertically opposite
(C) alternate (D) none

Q.94 In the above figure ∠e and ∠g are called
(A) corresponding (B) vertically opposite
(C) alternate (D) none

Q.95 In the above figure ∠c + ∠f =
(A) 90º (B) 120º (C) 180º (D) 160º

Q.96 In the above figure ∠a = 115º. The ∠g
(A) 180º (B) 120º (C) 140º (D) none

Q.97 If two lines l and m are perpendicular to each other than they are symbolically written as
(A) $l \parallel m$ (B) $l \perp m$
(C) $l = m$ (D) l m

Q.98 Number of pairs of corresponding angles formed when a transversal intersects a pair of line is
(A) 2 pair (B) 4 pairs
(C) 3 pairs (D) 8 pairs

Q.99 Number of pairs of alternate angles formed when a transversal intersects a pair of lines is
(A) 2 pair (B) 4 pairs
(C) 3 pairs (D) 8 pairs

Q.100 Sum of two interior angles lying on the same side of transversal is _______ .
(A) complementary (B) supplementary
(C) acute angles (D) right angles

Q.101 At 4.24 pm, how many degrees has the hour hand of a clock moved from its position at noon ?
(A) 132º (B) 135º
(C) 140º (D) 145º

Q.102 Two angles are called adjacent if -
(A) they lie in the same plane and have a common vertex
(B) they have a ray in common
(C) the intersection of their interiors is empty
(D) all the above

Q.103 The sum of the exterior angles of a hexagon is
(A) 360º (B) 540º
(C) 720º (D) none of these

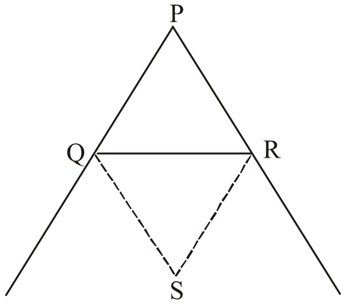
Q.104 The sum of all the angles of a pentagon are-
(A) 360º (B) 540º
(C) 720º (D) none of these

Q.105 The angle that is three times as large as its comlement is -

(A) 135º (B) 67.5º

(C) 50.5º (D) 45º

Q.106 In this fig QS and RS are beisectors of exterior angles Q and R. The ∠QSR + ∠P/2 is equal to–



(A) 270º (B) 180º

(C) 90º (D) 60º

Q.107 The angle which is twice its supplement is-

(A) 120º (B) 90º

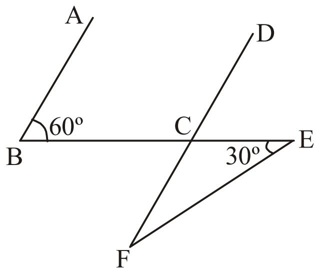
(C) 60º (D) 30º

Q.108 The angle which exceeds its complement by 20º is -

(A) 45º (B) 55º

(C) 70º (D) 110º

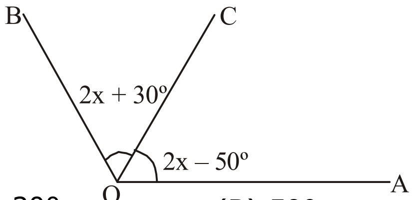
Q.109 In the figure AB || CD, then ∠EFD is equal to–



(A) 20º (B) 25º

(C) 30º (D) 35º

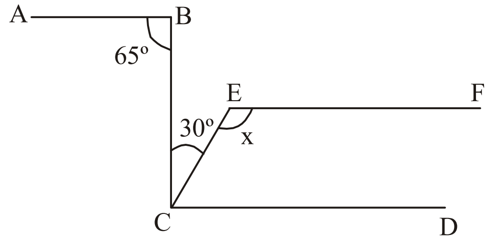
Q.110 What value of x will make AOB a straight line ?



(A) 30º (B) 50º

(C) 49º (D) none of these

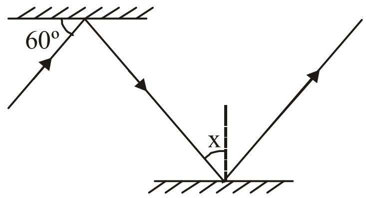
Q.111 What value of x will make CD || EF, if AB || CD ?



(A) 150º (B) 145º

(C) 140º (D) 135º

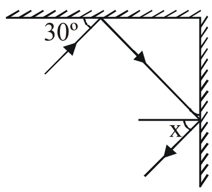
Q.112 The value of x in the following figure is–



(A) 30º (B) 45º

(C) 60º (D) none of these

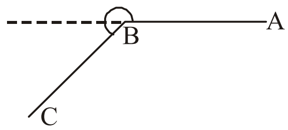
Q.113 Find the value of x in the given figure.



(A) 30º (B) 35º

(C) 40º (D) 45º

Q.114 Angle ABC in the following figure is a/an



(A) acute angle (B) obtuse angle

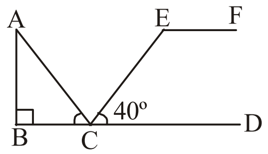
(C) reflex angle (D) straight angle

Q.115 The sum of the angles at a point is -

(A) 0º (B) 90º

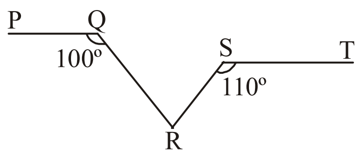
(C) 180º (D) 360º

Q.116 In the figure if BD || EF, then $\angle$CEF is



(A) 100°   (B) 120°
(C) 140°   (D) 160°

Q.117 In the figure PQ || ST, then $\angle$QRS is equal to

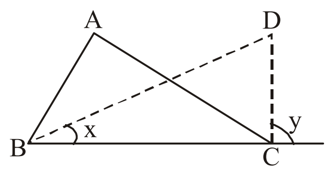


(A) 30°   (B) 40°
(C) 50°   (D) 60°

Q.118 The angle which is one fifth of its complement is
(A) 15°   (B) 30°
(C) 45°   (D) 60°

Q.119 The angles which is one fifth its supplement is
(A) 15°   (B) 30°
(C) 45°   (D) 60°

Q.120 In the adjoining figure, BD and CD are angle bisectors. Then, which of the following is true?



(A) $\angle D = \frac{1}{2}\angle A$
(B) $\angle x + \angle y = \angle A + \angle D$
(C) $\angle D = \frac{\angle x + \angle y}{2}$
(D) All of the above

ANSWER KEY

1.	A	**2.**	D	**3.**	C	**4.**	B
5.	D	**6.**	B	**7.**	B	**8.**	B
9.	C	**10.**	B	**11.**	A	**12.**	C
13.	A	**14.**	B	**15.**	A	**16.**	C
17.	B	**18.**	C	**19.**	C	**20.**	D
21.	B	**22.**	C	**23.**	A	**24.**	B
25.	A	**26.**	C	**27.**	B	**28.**	C
29.	B	**30.**	C	**31.**	B	**32.**	A
33.	B	**34.**	C	**35.**	C	**36.**	C
37.	A	**38.**	C	**39.**	B	**40.**	A
41.	C	**42.**	D	**43.**	B	**44.**	B
45.	A	**46.**	B	**47.**	B	**48.**	D
49.	A	**50.**	D	**51.**	D	**52.**	B
53.	C	**54.**	A	**55.**	A	**56.**	C
57.	A	**58.**	B	**59.**	A	**60.**	B
61.	D	**62.**	A	**63.**	B	**64.**	A
65.	C	**66.**	B	**67.**	B	**68.**	A
69.	D	**70.**	B	**71.**	C	**72.**	B
73.	C	**74.**	B	**75.**	B	**76.**	A
77.	D	**78.**	B	**79.**	B	**80.**	A
81.	B	**82.**	B	**83.**	A	**84.**	B
85.	B	**86.**	A	**87.**	D	**88.**	C
89.	B	**90.**	C	**91.**	B	**92.**	B
93.	A	**94.**	B	**95.**	C	**96.**	A
97.	B	**98.**	B	**99.**	A	**100.**	B
101.	A	**102.**	D	**103.**	A	**104**	B.
105.	B	**106.**	C	**107.**	A	**108.**	B
109.	C	**110.**	B	**111.**	B	**112.**	A
113.	A	**114.**	C	**115.**	D	**116.**	C
117.	A	**118.**	A	**119.**	B	**120.**	A